EXHIBIT E

**UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF KANSAS**

IN RE URETHANE ANTITRUST LITIGATION	)))) MDL 04-1616 (JWL/JPO)
	)))
THIS DOCUMENT RELATES TO: POLYETHER POLYOL CASES	) Civil Action Nos. 08-2617, 09-2026, 10-2077))))

REVISED REPLY REPORT OF MATTHEW E. RAIFF, PH.D.

**May 25, 2012
Revised July 13, 2012**

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1. Executive summary

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(1)   I have been engaged by Counsel for the 11 Direct Action Plaintiffs ("Plaintiffs") in this litigation to determine whether, and the extent to which, Plaintiffs were overcharged as a result of a conspiracy among suppliers of TDI, MDI, and polyether polyols (collectively "polyether polyol products").

(2)   On April 15, 2011, I submitted an expert report on behalf of Plaintiffs ("Raiff report").[1] Defendants later questioned me under oath for two days regarding the opinions I expressed in my report. On March 23, 2012, Defendants Dow and BASF submitted an expert report from Dr. Keith R. Ugone, who stated that he was retained "as an economics and damages expert" and asked by Defendants to "evaluate" my opinions.[2] Defendants Dow and BASF also submitted an expert report from Dr. Kenneth G. Elzinga, who stated that he was retained to make "a determination as to whether [Defendants'] behavior is consistent with the operation of a cartel or instead squares with independent, head-to-head competition."[3]

(3)   In this Reply, I respond to the criticisms of my opinions. None of these criticisms lead me to change my conclusions. As a result, I continue to hold the opinions expressed in my initial report. Here, I focus on responding to those points, which, if they were valid, would have a quantitatively significant effect on my opinions and certain areas where there are either misunderstandings or misrepresentations of my analysis. The remainder of my report discusses specifics. In particular, I have reached the following major opinions about the Defendants' expert reports.

(4)   First, while professing not to be offering an opinion on liability, Dr. Ugone devotes extensive passages of his report to justify his apparent belief that "indicators of competition" preclude a finding that the Defendants effectively conspired. Similarly, Dr. Elzinga opined that "economic evidence" establishes that the Defendants did not enter into agreements to restrict competition in polyether polyol products by issuing price change announcements that would be effective on the same day.[4] These opinions suffer from significant flaws. On the factual side, Dr. Ugone admitted that he was not provided with certain evidence of collusion, and Dr. Elzinga admitted that he only looked at evidence contrary to a "hypothesis that there's a cartel operating in this

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[1]   On May 13, 2011, I submitted a revised version of this initial report. References to the "Raiff report" are to my revised report.

[2]   Rebuttal Expert Report of Keith R. Ugone, Ph.D. Responding to the Expert Report of Dr. Raiff (hereinafter Ugone report) at ¶¶ 1, 3 (Mar. 23, 2012).

[3]   Economic Expert Report of Professor Kenneth G. Elzinga (hereinafter Elzinga report) at 2–3 (Mar. 23, 2012).

[4]   Dr. Elzinga testified that he only evaluated the claim that there were meetings and agreements on prices and that "the mechanism" for raising prices was through simultaneous price increase announcements. Deposition of Kenneth G. Elzinga (hereinafter Elzinga deposition) at 309:18-316:25, 324:10-326:4 (May 4, 2012).

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industry." [5]   Therefore, neither Dr. Ugone nor Dr. Elzinga was provided with what I would consider to be a fair representation of the evidence.

(5)   Furthermore, both Drs. Ugone and Elzinga make unrealistic assumptions about the operation of cartels for which there is no empirical or theoretical support. Both Drs. Ugone and Elzinga appear to believe that conspiracies are nearly perfect mechanisms to raise prices, which is inconsistent with what is known about the real-world operation of cartels. [6] Operating in secrecy, conspiracies tend to be imperfect mechanisms to elevate prices above competitive levels. [7] Even highly sophisticated cartels are characterized by episodes of noncompliance by cartel members, deceptive practices when it comes to monitoring, and sales representatives ignorant of collusion disrupting the agreement. For example, Dr. Ugone opines, without any support, that in price-fixing cases, "one expects to see an increase in the observed prices for the at-issue products during the alleged conspiracy." [8] In fact, many conspiracies arise in industries that are under price pressure and exist to limit the losses that would otherwise be sustained in the presence of competition.

(6)   Second, neither Dr. Ugone nor Dr. Elzinga developed their own econometric model to contradict the results of my econometric analysis. While Dr. Ugone criticizes my results, he does not deny that the fundamental methodology that I used was appropriate nor does he estimate his own econometric model. [9] Rather, he merely questions aspects of the manner in which Dr. McClave

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[5]   Elzinga deposition at 78:4-81:2 (May 3, 2012); Deposition of Keith R. Ugone (hereinafter Ugone deposition) at 529:1–535:19, 545:8–546:4 (Apr. 16, 2012). For example, neither Dr. Ugone nor Dr. Elzinga read the deposition of Stephanie Barbour, the full deposition of Larry Stern, the depositions of other witnesses that claimed to have knowledge of collusive discussions, or the depositions of witnesses who asserted their Fifth Amendment rights in response to questions regarding the conspiracy. *See* Ugone deposition at 529:1-542:10, 545:8-546:4; Elzinga deposition at 69:5-70:11, 87:18-90:24. Similarly, it appears that Drs. Ugone and Elzinga were unaware of evidence that executives engaged in acts of subterfuge, such as using pay phones and calling cards to contact competitors, talking with competitors outside of their offices, or sweeping their offices for listening devices. *Id.*

[6]   This proposition is abundant in the literature. *See, e.g.,* Margaret C. Levenstein and Valerie Y. Suslow at 14, "Studies of Cartel Stability: A Comparison of Methodological Approaches," in Peter Z. Grossman, ed., *How Cartels Endure and How They Fail* (Northampton, MA: Edward Elgar Publishing, 2004); Dennis W. Carlton and Jeffrey M. Perloff , *Modern Industrial Organization*, 4th ed. (2005) (hereinafter Carlton and Perloff (2005)) at 122–54.

[7]   *See, e.g.* Margaret C. Levenstein and Valerie Y. Suslow, *What Determines Cartel Success?,* J. of Econ. Lit., Vol. XLIV (March 2006); *United States v. AU Optronic, et. al.,* Case No. CR 09-00110 SI, Transcript of Proceedings ("AUO Trial Tr.") at 4517 (Feb. 22, 2012).

[8]   Ugone report at ¶ 66. Dr. Elzinga makes a similar, and equally unsupported, pronouncement. Elzinga report at 64–66.

[9]   In footnote 12 of Dr. Ugone's report, he points out that "[c]ontrary to the updated claimed damages tables contained in the Revised Raiff Report (Figures 2–5), the text of the report claims damages of $596.5 million during the conspiracy period and $370.8 million during the class period." The dollar amounts in Figures 2–5 were appropriately updated when I submitted my revised report on May 13, 2011. These Figures contain the accurate damage amounts. The dollar amounts cited in the text of my revised report referred to the damages from my original report dated April 15, 2011, and should have been updated as well.

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and I applied our respective methodologies to the facts of this case.[10] For the most part, Dr. Ugone's report consists of a series of assertions following from a series of inappropriate changes to my data and model. After making these inappropriate changes, Dr. Ugone's opinion appears to be entirely dictated by his view that there should be no damages given his speculation that the conspiracy either did not exist or was wholly ineffective.

(7)   Third, the methodology that I used has been applied and endorsed by courts in other price-fixing cases, including *Vitamins*, *Linerboard*, and *DRAM*. As explained in my initial report, my econometric analysis allows me to consider, and reject, the assertions by Drs. Ugone and Elzinga that normal supply and demand factors fully explain the prices charged by the Defendants during the conspiracy period.

(8)   The remainder of my report addresses these and other points in more detail. Section 2 discusses the alleged evidence of competition cited by Drs. Ugone and Elzinga. Section 3 describes how my econometric model reflects widely recognized and well-established best practices.[11] Section 4 responds to the remaining issues.

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[10]   Rebuttal Expert Report of Keith R. Ugone, Ph.D. Responding to the Expert Report of Dr. McClave (hereinafter Ugone report responding to McClave), Mar. 23, 2012.

[11]   Technically, I estimated a two-step econometric model. The first step models prices of TDI 80/20, PMDI, and CFS polyols. The second step models individual transaction prices for TDI, MDI, and polyols. Unless otherwise specified, when I say "model" I am referring to the common methodology that I used to estimate these models.

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2. Alleged "indicators of competition" are consistent with the existence of a conspiracy

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2.1. Introduction

(9)   Dr. Ugone argues that I failed to consider so-called "indicators of competition" and somehow failed to "reconcile" the results of my empirical analysis with "contradictory economic evidence."[12] Dr. Ugone's argument misses the point for several reasons.

(10)   First, I start from the proposition that the jury will have concluded that the Defendants entered into unlawful agreements to restrict competition. The only questions I address are whether those agreements harmed the Plaintiffs and, if so, to what extent.

(11)   In evaluating those questions, I reviewed the underlying evidence to inform my understanding of the industry, the behavior of the conspiracy, the period over which it operated, and other related topics.[13] But this was merely the first step of my analysis. If I had stopped there, I would be left only with a subjective evaluation of the evidence. While this subjective evaluation may be informed by economic theory or my personal experience in studying conspiracies, it cannot scientifically weigh potentially conflicting evidence.[14] Resolving conflicting evidence and factual ambiguities in documents and testimony is the domain of the jury and not economists. Economists may provide unique insight, however, by employing econometric methods to quantify the damages resulting from a conspiracy. That is why I went beyond a subjective evaluation of the evidence and designed an econometric model based on best practices, to accurately and reliably estimate the impact, if any, of the conspiracy on prices.[15]

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[12]   Ugone report at ¶¶ 49–84.

[13]   There is no commonly accepted method for deriving estimates of overcharges from the types of "indicators" advanced by Drs. Ugone and Elzinga.

[14]   The point discussed by Drs. Ugone and Elzinga that the "indicators" cannot by themselves reliably lead to a conclusion about overcharges is clearly explained in the scientific literature studying cartel success. For example: "Why one cartel fails and another endures is a question that as empirical researchers often note can never be definitively answered. It is by no means clear in the literature exactly which industry characteristics are more or less likely to lead to cartel success, or which will guarantee failure. There are no categorical sufficient or even necessary conditions for cartel success." Peter Z. Grossman, "Why One Cartel Fails and Another Endures," in Peter Z. Grossman, ed., *How Cartels Endure and How They Fail*, at 117 (Northampton, MA: Edward Elgar Publishing, 2004); "We find that there is no simple deterministic relationship between cartel structure, market structure, and cartel behavior. Cartels with strikingly different organizational characteristics can be failures or successes. This study illustrates that cartels can and do operate in a variety of industry and market conditions." Valerie Y. Suslow (2005), "Cartel Contract Duration: Empirical Evidence from Inter-war International Cartels," *Industrial and Corporate Change* 14, n. 5 (2005) at 735.

[15]   *Proof of Conspiracy Under Federal Antitrust Laws*, 2nd ed. (Chicago: American Bar Association, 2010) at 224. ("Economists can use regression techniques to estimate the impact of allegedly conspiratorial activity on observed market outcomes. If no impact can be identified after controlling for unrelated competitive effects—such as exogenous changes in cost, demand, entry or exit, and regulation—it may be argued that there was in fact no conspiracy, or, at least, if a conspiracy existed, it was not material, as there was no measurable effect. If an impact can be identified and associated with the allegedly collusive activity, this correlation may be interpreted as evidence that defendants worked together to raise prices, restrain supply, or otherwise increase profitability by reducing

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(12)   My econometric model accounts for all of the "indicators of competition" that Dr. Ugone claims I ignored, and which Dr. Elzinga claims prevent a finding of unlawful agreement. My econometric model accounts for the extent to which supply and demand factors drove price changes, and establishes that these factors fail to fully account for the movement of prices during the conspiracy period.[16, 17] If the alleged conspiracy had no effect on prices, then my econometric model would have returned zero or near zero overcharges.[18] According to several empirical surveys, most conspiracies succeed in artificially elevating prices above competitive levels.[19]

(13)   In addition, my finding of overcharges is consistent with the structure of the urethanes industry, as I described in my initial report.[20] As Dr. Elzinga admits, the polyurethanes industry was an oligopoly with fairly non-differentiated products.[21] While Dr. Elzinga said he is not "persuaded" that "barriers to entry" existed, we appear to agree on the underlying fact that the Defendants did not view potential entrants as a significant constraint on pricing.[22] Moreover, demand was inelastic.[23] These factors are all known to be conducive to successful collusion.[24]

(14)   Although I properly rely upon qualitative evidence to design my econometric model and to assess its results, Drs. Ugone and Elzinga rely heavily on a subjective review of a limited portion of the discovery record to form their opinions. Because they failed to consider evidence of conspiracy

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competition.") (citation omitted); *See also* Reference Manual on Scientific Evidence, ABA Section of Antitrust Law (2d ed. 2000) at 181–85.

[16]   In addition to accounting for supply and demand factors, my econometric model also accounts for idiosyncratic pricing differences across, among other things, Defendants, Direct Action Plaintiffs, and products. See Section 3.2.1.

[17]   Dr. Ugone admitted that if he had been asked by plaintiffs to determine impact and damages, he would have estimated a regression model. Ugone deposition at 520:12-522:24.

[18]   By chance, one might find near zero overcharges if true overcharges were in fact zero. My model results cannot be explained as the result of chance. I discuss this issue in Section 3.8 of my report.

[19]   *See, e.g.*, *Antitrust Modernization Commission, Report and Recommendations* (2007) at ix, 301, available at http://govinfo.library.unt.edu/amc/report_recommendation/toc.htm; Oxera Consulting et al., *Quantifying Antitrust Damages: Toward Non-Binding Guidance for Courts* (2009) at 89–92, available at http://ec.europa.eu/competition/antitrust/actionsdamages/quantification_study.pdf. One recent study found that of 30 domestic cartels in the 1990s and 2000s, only one had zero estimated overcharges. John Connor and Robert Lande, "How High Do Cartels Raise Prices? Implications for Optimal Cartel Fines," *Tulane Law Review* 80 (2005) at n. 219. As Dr. Elzinga acknowledged, economists assume that people act rationally. That assumption supports the view that business executives will engage in unlawful price-fixing conduct only if they believe that the expected benefits outweigh the expected risks. *See, e.g.,* Carlton and Perloff (2005) at 131.

[20]   Raiff report at ¶¶ 196–200.

[21]   Elzinga deposition at 361:21-362:2.

[22]   Elzinga report at 130. In his deposition, Dr. Elzinga clarified that there were barriers to entry under one standard and that there "might be" barriers to entry under a second standard. Elzinga deposition at 277:10-280:25. Dr. Elzinga had previously conceded that "One of the characteristics of the urethanes industry is the high cost of building new plants." Elzinga report at 121.

[23]   *See, e.g.,* Deposition of Robert Wood (Dow) at 112:10-15 (Feb. 10, 2010). Inelastic demand means that a conspiracy could raise price substantially by reducing output by a relatively small amount.

[24]   *See* Raiff report at ¶ 196.

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and refused to create their own econometric model, I do not find their opinions reliable or their criticisms meaningful.

2.2. Polyether polyol product prices are consistent with the existence of a conspiracy

(15)   Drs. Ugone and Elzinga make much of the fact that prices for the products at issue did not "experience a sustained rise during the conspiracy" and conclude from that fact that the Defendants could not have entered into effective unlawful agreements.[25]   Neither, however, cites any economic authority for this view.

(16)   In fact, virtually all conspiracies are imperfect. Prices vary over time, for various reasons. For example, the participants in the agreements may not all share the same view of the agreements, the participants may attempt to renegotiate the terms of the agreement through conduct,[26] and there will almost always be some level of cheating.[27]   Nevertheless, while rarely perfect, agreements among producers help to limit the risks involved in any unilateral attempt to increase prices, thereby inflating prices above the levels that would have been achieved in the absence of the conspiracy.

(17)   I am aware of several conspiracies that existed while prices were declining, among them rubber chemicals, polyester polyols, and *LCDs*.[28]   In most conspiracies, prices fluctuate over time. Dr. Ugone admitted as much in his deposition when confronted with a hypothetical used by the cofounder of Dr. Ugone's company, Analysis Group, showing that prices rose substantially *before* the conspiracy, fluctuated throughout the term of the conspiracy, and ended slightly higher at the end of the conspiracy.[29]   Even in highly sophisticated cartels like *Vitamins*,[30] the cartel was not always consistently successful in raising prices. That does not mean, of course, that there were no overcharges. To be effective, a conspiracy does not have to raise prices from one period to the next; the question is simply whether the conspiracy elevated prices above what the prices would have been in the absence of the unlawful conduct. Indeed, numerous examples of known

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[25]   Ugone report at ¶ 66; Elzinga report at 64–66.

[26]   *See, e.g.,* Margaret C. Levenstein and Valerie Y. Suslow, *International Cartels*, 2 Issues in Competition Law and Policy 1107, 1121 ("*International Cartels*") (ABA Section of Antitrust Law 2008).

[27]   *See, e.g.* Joseph E. Harrington, *How Do Cartels Operate?* at 43–72 (Hannover, MA: Now Publishers Inc., 2006).

[28]   There have been many conspiracies uncovered in the chemicals sector. *See, e.g.,* Deposition of Marco Levi (Dow) at 841:3–844:15 (May 21, 2010).

[29]   *See* Ugone deposition at 592:17–599:17; Ex. 11 to Ugone deposition; *Proving Antitrust Damages: Legal and Economic Issues* (1st ed. 1996), ABA Section of Antitrust Law at 173.

[30]   As noted in this Reply, BASF—through its fine chemicals division—was a central figure in the *Vitamins* cartels. Bayer was also involved in feed additive conspiracies through its involvement in the *Citric Acid* cartel.

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cartels exist in which during the allegation period, prices remained stable or declined.[31] I provide a few examples below.

A. <u>Rubber Chemicals</u>. The rubber chemicals conspiracy existed from at least 1995–2001.[32] It came to light when one company sought immunity in mid-2002, and international raids were carried out in September 2002, including of Bayer's offices. In Rubber Chemicals, the producers agreed to announce and implement price increases, not always with success. There was evidence that certain buyers fought the increases, that some increases were not successful, and that the conspiracy involved internal conflicts, rivalries, and cheating. During the time period of the conspiracy, prices generally declined.[33] In fact, one of the Rubber Chemicals conspirators argued to the European Commission that the conspiracy was largely ineffective, claiming that the powerful customers could not be seriously harmed by any collusion. The European Commission rejected the argument: the fact that, in spite of the conspiracy's efforts, the results sought by the participants were not entirely achieved, or the price increases could not be sustained, may illustrate the difficulties encountered by the parties in increasing prices in a specific market situation, but it does not prove in any way that the cartel was ineffective or that prices were not kept above competitive levels. Even though some price-increase attempts "failed," cartel members expressed *their* satisfaction on several occasions regarding the success of efforts to sustain prices in the presence of adverse industry conditions.[34]

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[31]   *How Cartels Endure and How They Fail* at 28–29 ("Because quite a few cartels were formed following a decline in price (either because of entry, market integration, technological change, or a decline in demand), cartel prices and profits might well be lower, or at least not higher than, those that prevailed in the pre-cartel period. A fall in profits after the formation of a cartel does not necessarily mean that the cartel was not successful. Profits might be higher than would have been the case *in the absence of the cartel*.") (emphasis in original).

[32]   The facts of this conspiracy are partially laid out in a 106-page decision issued by the European Commission Case COMP/F/38.443 – Rubber Chemicals (hereinafter Rubber Chemicals Decision); *see also* US Department of Justice, "Bayer AG Agrees to Plead Guilty and Pay $66 Million Fine for Participating in Rubber Chemicals Cartel," news release, July 14, 2004, http://www.justice.gov/atr/public/press_releases/2004/204602.htm.

[33]   Rubber Chemicals Decision at ¶ 214. ("Against this background, the phenomenon of declining price levels in the period 1996-1998 is not inconsistent with continuation of the cartel, in contrast to what Crompton maintains. Apart from the price war within the cartel, such trends could also possibly be explained by a decrease in the raw material prices or other factors. It may well also be true that no agreements on prices were made in a certain period within the duration of the infringement. This does not, however, imply that the infringement was totally suspended or terminated with regard to all of its elements. Internal conflicts, rivalries and cheating may occur, or a tacit agreement may even exist that no changes to the status quo were achievable, but this will not prevent the arrangement from constituting an agreement/concerted practice for the purposes of Article 81(1) of the Treaty where there is a single common and continuing objective to restrict competition in a particular market, as in this case.").

[34]   Rubber Chemicals Decision at ¶¶ 64, 286.

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B. <u>Polyester Polyols</u>. Bayer pleaded guilty and paid a $33 million fine for participating in a conspiracy to fix the price of adipic acid-based aliphatic polyester polyols, which are a form of urethane chemicals, from 1998–2002.[35] Bayer admittedly met with other major producers of polyester polyols and reached agreements to maintain and increase the price of polyester polyols. Nevertheless list prices for polyester polyols fell from 1998 to 2002.[36]

C. <u>ESBR</u>. Bayer sought and obtained leniency in connection with a conspiracy to increase the prices of butadiene rubber and emulsion styrene butadiene rubber ("ESBR") from 1996-2002.[37] The conspiracy was achieved by fixing price targets, sharing customers by non-aggression agreements, and exchanging sensitive commercial information relating to price, competitors, and customers.[38] Cartel meetings took place on the fringes of trade association meetings, usually informally and the main objective of the conspiracy was not to increase prices, but to stabilize prices to minimize the effects of weakening demand.[39]

D. <u>LCD Panels</u>. The international LCD conspiracy involved a number of producers and lasted at least from 2001–2006 (LCD panels are used in electronic devices such as computer monitors, TVs, laptops, and cell phones). The DOJ obtained evidence of more than 60 meetings among top executives of the conspirators. In addition to the conviction of Defendant AU Optronics ("AUO"), the DOJ obtained guilty pleas from seven companies, criminal fines totaling nearly $900 million, and prison sentences for 10 executives.[40] At trial AUO called an economics expert from the Analysis Group, Bruce Deal, who testified that the economic data were inconsistent with AUO's participation in a conspiracy, despite evidence of AUO's attendance at price-fixing meetings. Mr. Deal told the jury that AUO charged prices that were below the "floor" and "targets" set by the conspiracy, that there was significant dispersion of prices, that there was no evidence of cartel punishment, that AUO increased capacity, that AUO's market shares increased, and that AUO's profits actually increased after the conspiracy ended. According to Mr. Deal, AUO prices declined 12.4% annually

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[35]   Plea Agreement, U.S. v. Bayer Corp., No. CR 04-0318 VRW (May 24, 2005).

[36]   SRI Consulting, "CEH Product Review Polyester Polyols" in *Chemicals Economics Handbook* (2006), at 18.

[37]   The literature recognizes that firms that participate in one cartel are more apt to participate in others, primarily because they develop the rapport with their competitors and the organizational skills to make collusion more effective. *See International Cartels* at 1109.

[38]   Commission Decision of 29/11/2006, Case COMP/F/38.638 – Butadiene Rubber and Emulsion Styrene Butadiene Rubber ("ESBR Decision"). Dow and Enichem were among the participants in that cartel.

[39]   *See* ESBR Decision ¶¶ 95-98, 256-311.

[40]   US Department of Justice, "Taiwan-Based AU Optronics Corporation, its Houston-based Subsidiary and Former Top Executives Convicted For Role in LCD Price-Fixing Conspiracy," news release (Mar. 13, 2012), http://www.justice.gov/atr/public/press_releases/2012/281032.htm.

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during the cartel period.[41] Despite these claims, the jury unanimously convicted AUO and found that it caused more than $500 million in overcharges in the United States.[42]

    E. <u>Choline chloride (Vitamin B4)</u>. Choline chloride producers in Europe, including BASF, were found to have fixed the prices of choline chloride from 1988–1998. Prices trended downward. Nevertheless, the European Commission rejected the proposition that declining prices disproved a collusive agreement.[43]

    F. <u>OPEC</u>. Drs. Ugone and Elzinga both referred to this cartel in their reports and/or testimony. Although OPEC has been in operation for years as an organized cartel to limit supply among the world's leading oil producing countries, prices have fluctuated, volumes have fluctuated, cheating occurs, and the producers do not adhere to a unified business model.[44]

2.3. Price dispersion is consistent with the existence of a conspiracy

(18)   Dr. Ugone argues that my use of a weighted median price is "flawed" and "fails to provide important economic content" because of the variation in prices both charged by Defendants and paid by the Plaintiffs.[45] Specifically, he asserts that my use of a weighted median price "fails to provide economic information relating to the distribution of prices (or the competitive implication associated with the distribution of prices) over the periods in dispute."[46] Dr. Ugone's argument is incorrect. As I describe in Section 3.2 below, my econometric model accounts for the pricing structure in the industry, including price dispersion.

(19)   Furthermore, variations in price are consistent with the operation of a conspiracy. Price dispersion generally exists due to individualized differences in, among other things, relative negotiation skills and other customer- and product-specific issues. Price dispersion exists in

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[41]   AUO Trial Tr. at 4193–4509.

[42]   *See* US Department of Justice, "Taiwan-Based AU Optronics Corporation, its Houston-based Subsidiary and Former Top Executives Convicted For Role in LCD Price-Fixing Conspiracy," news release (Mar. 13, 2012), http://www.justice.gov/atr/public/press_releases/2012/281032.htm.

[43]   Commission Decision of 09/12/2004, Case COMP/E-2/37.533- Choline Chloride ¶¶ 194–96. ("In general, it appears that the price trend of choline chloride in the period of infringement in Europe was downward, linked to the developments in the price of raw materials.").

[44]   *See, e.g.,* Tarek El-Tablawy, "OPEC struggles to find balance in oil market," *San Diego Union-Tribune*, November 28, 2008, available at http://www.utsandiego.com/news/2008/nov/28/opec-meeting-112808/?print&page=all; Marianna Parraga, "Venezuela worries that OPEC is flooding oil market," *Reuters*, April 17, 2012, available at http://www.reuters.com/article/2012/04/17/venezuela-opec-idUSL2E8FHAE020120417.

[45]   Ugone report at ¶ 4.

[46]   Ugone report at ¶ 48.

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industries subject to collusion just as it does in non-collusive situations.[47] What matters is a conspiracy's ability to raise the price level higher than it otherwise would have been, not its ability to charge identical prices across customers.[48]

(20)   Dr. Ugone makes the related observation that he finds less price dispersion when looking only at specific products sold to specific Plaintiffs, but his narrow conclusion that this result is "consistent with what one would expect to see with competitive pricing" is incomplete.[49] In fact, the result is also consistent with what I would expect to see with collusive pricing. In general, purchasers seek to get comparable prices from their suppliers whether their suppliers are competing with one another or not.

2.4. Supply and demand conditions during the allegation period are consistent with the existence of a conspiracy

(21)   Dr. Ugone contends that "input pricing patterns are contradictory to Dr. Raiff's assertion that prices should have been lower during the claimed damages period – especially when key input costs were volatile or rising."[50] Similarly, Dr. Elzinga argues that for prices to be stable or decreasing during a conspiracy, "the economics of plaintiffs' allegations require that supply and demand conditions during the allegation periods were putting downward pressure on polyurethane prices that were offset by the operation of the cartel."[51]

(22)   In Figures 11–13 of his Rebuttal, Dr. Ugone compares indexed prices of MDI, TDI, and polyether polyols to an index of prices for key raw materials (benzene, toluene, and propylene, respectively) and argues that those materials exerted "upward pricing pressure" on each of these benchmark products.[52] In Exhibits 5–7 of his Report, Dr. Elzinga compares actual prices of MDI, TDI, and polyether polyols to indexed prices for key raw materials (benzene, toluene, and propylene, respectively) and argues that those "raw material prices do not provide a basis upon which one" could argue that polyurethane product prices should have fallen faster in a competitive market.[53] I have incorporated each of these raw materials into my econometric

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[47] *See, e.g.,* Dr. Bernheim's *Vitamins* report at 163, Figures 10-1 and 12-4.

[48] Dr. Ugone, in fact, was unable to identify any conspiracy that adhered to a "single price." Ugone deposition at 698:11-15.

[49] Ugone report at ¶ 41.

[50] Ugone report at ¶ 68.

[51] Elzinga report at 66.

[52] Ugone report at ¶ 68.

[53] Elzinga report at 70–73.

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models, and the results of my models demonstrate that those input cost increases do not fully account for the prices that Defendants charged during the conspiracy.

(23)   The graphical representations in Dr. Ugone's Figures 11–13 and Dr. Elzinga's Exhibits 5–7 are highly misleading. Despite the fact that the raw data were measured in dollar units, both Drs. Ugone and Elzinga chose to display the input prices as an index. By doing this, they greatly exaggerated the movements in the input cost series. The fact that these movements are exaggerated can be clearly seen in Dr. Ugone's Figures 11–13,[54] in which the input costs appear to exceed the benchmark product category prices in 2004 and after. Similarly, in Dr. Elzinga's Exhibits the input costs appear to exceed the benchmark product category prices at various points of time.

(24)   In Figure 1 below, I illustrate how actual input prices moved compared to the actual benchmark product category prices. Using TDI and toluene as an example, the actual price of toluene (in blue) is only a fraction of the price of TDI (in green). Additionally, I have accounted for the fact that it takes less than a pound of toluene to make a pound of TDI (as captured by the red line).[55]

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[54]   These charts are also contained in the Ugone report at Exhibit 38.
[55]   BC/PUR0293702; BC/PUR0293706.

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Figure 1 Actual TDI prices, actual toluene prices, and toluene price per pound of TDI
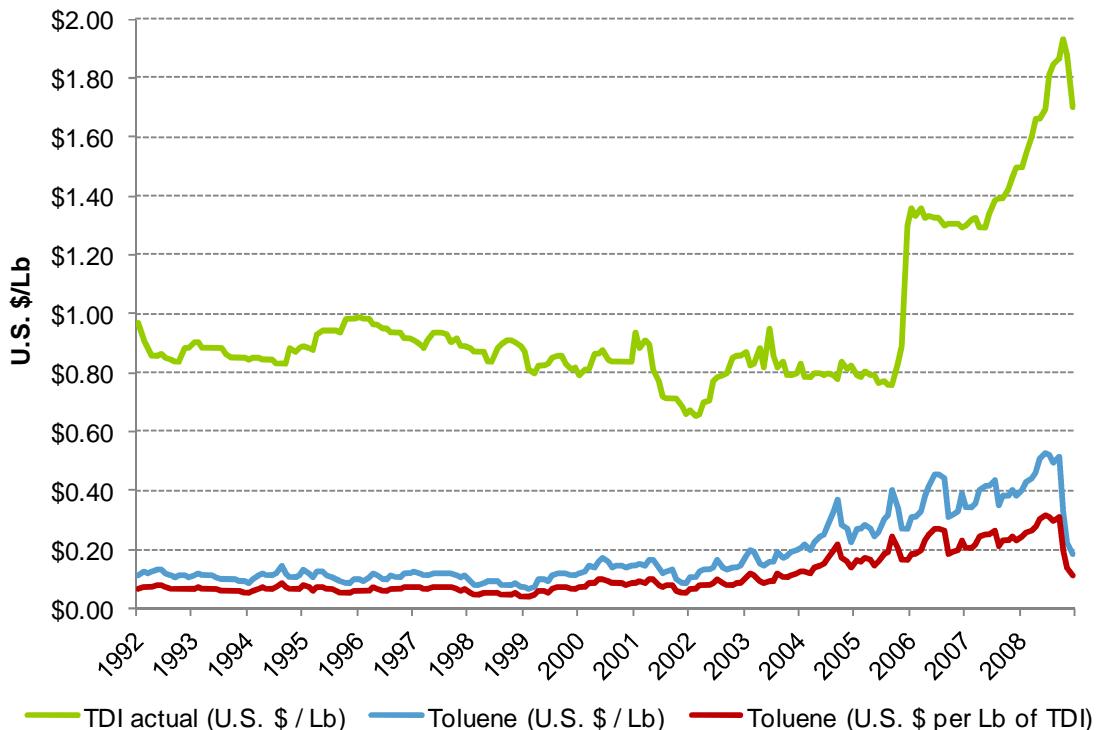
(25) Comparable charts for MDI and polyols likewise show how visually misleading Drs. Ugone and Elzinga's charts are.[56]

(26) Dr. Ugone's additional discussion of demand and supply conditions, in Sections IX.C and IX.D of his report, consists of a superficial recitation of excerpts taken from various trade publications. Dr. Ugone never tried to determine how those demand and supply factors actually influenced price during the conspiracy period. This is exactly what Dr. McClave and I did through econometric analysis.

(27) Dr. Ugone offers "increased environmental regulations" as a partial explanation for pricing patterns in 1994–1996.[57] I have reviewed the materials Dr. Ugone relied upon for this assertion and none of them directly discuss the cost impact of these regulatory changes on Defendants. More importantly, Dr. Ugone performs no analysis to show that these "environmental regulations" had any impact on Defendants' costs or prices. Looking at the specific sources that

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56 These charts can be found in my backup materials.

57 Ugone report at ¶ 76.

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Dr. Ugone relies upon reveals that they generally concern other industries or general trends, not polyether polyol products or the Defendants specifically. Ultimately, these references provide little support for Dr. Ugone's claim that these regulations help explain Defendants' elevated prices during 1994–1996.[58]

(28)   I also note that Dr. Elzinga failed to consider the cost cutting business strategies that the Defendants pursued as explained in detail over 30 pages within his Report.[59] For each (Bayer, BASF, Dow, Huntsman, and Lyondell), Dr. Elzinga detailed that part of their business strategy was to reduce costs. Whether it was freight costs, investing in new, cost-efficient facilities, or researching new technologies, each Defendant sought to reduce their operating cost. As such, as a matter of economics, looking only at the supply side, it is quite plausible that but-for the conspiracy, cost cutting measures taken by the Defendant companies would have led to larger declines in prices than the ones actually seen.

2.5. Customer switching and changes in the purchasing mix are consistent with the existence of a conspiracy

(29)   Dr. Ugone argues that in a price-fixing conspiracy, "one would expect to find that the purchasing mix of the Direct Action Plaintiffs would be relatively stable during the claimed conspiracy period."[60] Similarly, Dr. Elzinga cites selected evidence of "active competition" as proof that a

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[58]   Dr. Ugone writes that due to "new air pollution regulations…a number of refineries may shut down." Ugone report at ¶ 76(a), quoting Elizabeth S. Kiesche, Marjorie Coeyman, and Allison Lucas, "US chemicals: easing onto the road to recovery," *Chemical Week,* (April 13, 1994). Dr. Ugone suggests that this would affect the Defendants' costs and prices. However, this quote pertains to the possibility that petroleum refiners may shut down due to environmental regulations. The article does not state that Defendants faced, or would face, new or increased costs due to these Clean Air Act requirements. Moreover, my model accounts for the extent to which these possible closures increased the prices of petroleum-based urethanes inputs.

Dr. Ugone quotes, "without a doubt prices are up" in part because of environmental regulations in order to suggest that these same environmental regulations would place additional costs on Defendants (Ugone report at ¶ 76(b)(i), quoting "Prices up; materials demand could slow for rest of year," *Modern Paint and Coatings* (August 1, 1995). However, Mr. Gaither, the person quoted, was not employed by a polyurethanes producer such as Defendants. Rather, as reported by the article, Mr. Gaither was a producer of "resins based on acrylic, alkyd, urethane, polyester, vinyl, epoxy, amino, and oilseed chemistries." There is no indication that the cost increases he mentioned affected the polyurethanes industry or Defendants specifically.

Lastly, Dr. Ugone quotes, "spending on plant environmental, health and safety compliance due to governmental regulations has rapidly accelerated," as support for his claim that increased environmental regulations resulted in higher costs for Defendants. Ugone report at 76(b)(ii), quoting "Suppliers face tighter margins, fewer customers," *Modern Paint and Coatings* (August 1, 1996.) However, David Warnke, the identified source for the above information, did not work for a polyurethanes producer such as Defendants. Moreover, Mr. Warnke's comment concerned one of his suppliers who is not a polyurethanes producer.

[59]   Elzinga report at 29–63.

[60]   Ugone report at ¶ 52. Note, however, that Dr. Ugone admitted that customer switching could take place during a price-fixing conspiracy. Ugone deposition at 230:15-231:12.

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conspiracy could not exist. However, neither Dr. Ugone nor Dr. Elzinga identifies any economic authority for that position.

(30)   I have seen evidence of the type cited by Drs. Ugone and Elzinga in every price-fixing case in which I have been involved. In *Vitamins*, for example, if one only looked at the testimony of buyers and documents relating to price negotiations, one would have no idea that the producers engaged in one of the most harmful and pervasive conspiracies uncovered through that time.[61] Similarly, the testimony in the *LCD* criminal trial indicates that buyers shopped for better deals.[62]

(31)   As discussed above, price-fixing conspiracies exist on a spectrum from highly sophisticated to more loosely organized. No conspiracy is perfect. In fact, the literature recognizes that conspirators typically cheat on agreements and that lower-level sales personnel for a conspirator often do not know about the unlawful agreements.[63] Moreover, it is natural that buyers would attempt to negotiate with, and switch, suppliers in an effort to obtain better contract terms.[64]

(32)   I am also aware of evidence indicating that some of Defendants' sales personnel were criticized by executives alleged to be knowledgeable about the unlawful agreements for seeking business from companies traditionally associated with certain suppliers, for example Bayer's overtures to Firestone.[65] In this regard, "indicators of competition" can also be viewed as indicators of enforcement. Both Drs. Ugone and Elzinga cite evidence of "retaliation" by producer A against producer B; this is consistent with the view that producer B broke a preexisting agreement to maintain prices and/or not to "poach" customers.[66]

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[61]   US Department of Justice," Appendix A: Antitrust Division Selected Criminal Cases April 1, 1996 through September 30, 1999," http://www.justice.gov/atr/public/4523d.htm. ("The vitamin cartel is the most pervasive and harmful criminal antitrust conspiracy ever uncovered by the Division.").

[62]   AUO Trial Tr. at 2555:18–2556:10. The prices charged by LCD conspirators were routinely below agreed upon targets. *See, e.g.,* AUO Trial Tr. at 4264, 4283.

[63]   *See How Do Cartels Operate?* at 69–72, ("A rather different source of disruption arises from employees of the colluding firms who are not themselves aware of the collusive arrangement").

[64]   *See, e.g.,* Rubber Chemicals Decision at ¶ 67.

[65]   *See* Second Collective Amended and Supplemental Responses to Defendants' First Set of Merits Interrogatories, dated Sept. 8, 2011 at 62–63.

[66]   *See How Do Cartels Operate?* at 62–64, § 3.2.2; Carlton and Perloff (2005) at 140 ("The very successful bromine cartel lasted from 1885 to 1902. During its reign, the average price of bromine was about 25 percent higher than the average in the years before the cartel's formation. There were only three periods of extended price wars over the cartel's roughly 20-year life span." "Indeed, inventories were sold during price wars in 1886 and 1888 in order to punish competitors and to restore pricing discipline.") .

Carlton and Perloff (2005) at 145. ("During the 1880s, a cartel of U.S. railroads openly operated as the Joint Executive Committee…On a number of occasions, however, when the cartel thought that cheating had occurred, it cut prices for a time, and then returned to the cartel price…Porter also finds that price was 66 percent higher and quantity was 33 percent lower in co-operative periods. As a result, the cartel as a whole earned about 11 percent more revenues in cooperative periods.").

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(33)   Furthermore, Dr. Elzinga in the past has noted the difficulty of finding stable market shares in a conspiracy involving market allocation. In an article he authored, titled "New developments on the cartel front," Dr. Elzinga wrote that "[i]n the evidence of cartel behavior I surveyed, there is ample illustration of cartels seeking to meet very specific market share goals among their members. But either because those good at it have covered their tracks, or because most cartels are not durable, to find examples of cartel member market shares for Posner's requisite 'substantial period of time' so as to measure their instability or turnover is difficult."[67] Thus, if it is difficult to find stability in market share in a very specific market allocation cartel, then it will be especially difficult to find stable market shares in a conspiracy in which there was a less precise agreement on market allocation.

2.6. Alleged strategic differences among Defendants are consistent with the existence of a conspiracy

(34)   Dr. Elzinga asserts that Defendants Bayer, BASF, Huntsman, Dow, and Lyondell all pursued somewhat different business strategies.[68] While Dr. Elzinga admits that this alleged "fact" does not disprove that a cartel existed, he nevertheless speculates that "it is not evident why firms, endeavoring to sustain a cartel, would adopt heterogeneous business models."[69] Dr. Elzinga did not cite any academic or economic authority for this aspect of his opinion.

(35)   Conspirators may disagree on how to operate but still agree to restrict competition.[70] For example, Dr. Elzinga's argument that some urethane producers sought to sell their product through "systems" while others did not is reminiscent of *Vitamins*, where some producers sought to sell vitamins through "premixes" while others sought to sell "straight" vitamins to premix makers.[71] Those different strategies did not prevent the *Vitamins* conspirators from operating a highly sophisticated cartel. Similarly, OPEC members historically have pursued different strategies.[72] Thus, pursuing different strategies says nothing about the existence of a cartel.

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[67]   Kenneth G. Elzinga, "New developments on the cartel front," *Antitrust Bulletin* 29 (1984): 3–26.

[68]   Elzinga report at 29.

[69]   Elzinga report at 29; *see also* Elzinga deposition at 331:2-333:12.

[70]   For example, consider the OPEC conspiracy. Just recently, Venezuela complained that some member companies were pursuing different strategies, Marianna Parraga, "Venezuela worries that OPEC is flooding oil market," *Reuters*, April 17, 2012, available at http://www.reuters.com/article/2012/04/17/venezuela-opec-idUSL2E8FHAE020120417. In addition, Nigeria is reputed to be a notorious cheater on the OPEC agreements. Elzinga deposition at 97:19-98:24. Nevertheless, there is no question that the members of OPEC have agreed to restrict output in an effort to manipulate prices.

[71]   *See* European Commission Decision of 21/11/2001 (Case COMP/E-1/37.512 – Vitamins) ("*Vitamins EC Decision*") at ¶¶ 20–21.

[72]   *See* n. 44, 70.

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(36)   Further, the evidence indicates that the business strategies are not as "heterogeneous" as Dr. Elzinga describes them to be. In fact, at times, they are quite similar (in particular as pertains to Bayer, BASF, and Dow).

- **Bayer**: Dr. Elzinga writes that Bayer pursued a "price before volume" strategy.[73] The same maxim "price before volume" was the underlying principle of the *Vitamins* conspiracy.[74]

- **BASF**: BASF pursued profit maximization through a strategy focusing on high margin businesses[75] while making capital investments to "exploit economies of scale" in order to obtain a cost advantage.[76] The corollary of pursuing high margin business is to forego low margin business. In practice, like Bayer, BASF appeared to pursue a price before volume strategy during the conspiracy. For example, one internal BASF document states that BASF "Took Firm Stance on Price Increases in 2002 – Improved Margins – Lost Market Share – Exceeded 2002 Plan EBIT."[77]

- **Dow**: Dow's business strategy was to exploit the cost advantage it had achieved in propylene oxide ("PO"), by "providing PO at an attractive shadow price to its own derivative businesses, and to develop a new process technology."[78] Like Bayer and BASF, Dow's strategy is wholly consistent with a cartel operating in the background. In fact, the competitive pressures Dow was facing in PO due to Bayer and BASF becoming more self reliant for PO may have created internal pressure within Dow to improve its margins.[79] Notably, Dr. Elzinga's notes of his interview with Steven English refer to Dow's policy of "'chopping the tail,' a phrase that [I gather] means dropping business with unacceptably low margins."[80]

- **Huntsman**: Huntsman's strategy was to focus on profitable and growing markets "and to provide a constellation of products, services, and pricing that would enable both the customer and Huntsman to profit."[81] Like the other producers, Huntsman's strategy as described by Dr. Elzinga was wholly consistent with a cartel operating in the background.

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[73] Elzinga report at 30.

[74] *Vitamins EC Decision* at ¶ 165.

[75] Elzinga report at 42 ("[B]ASF did not pursue sectors like wood-binding segment, where value-added is low, and preferred to target segments like laminate board or systems, where value-added is greater.")

[76] Elzinga report at 38.

[77] BASF Corporation US 0997873.

[78] Elzinga report at 48.

[79] Dr. Ugone never acknowledges Dow's interest in its PO business as the driver of its Urethanes business strategy.

[80] Elzinga deposition at 237:6-240:1.

[81] Elzinga report at 44.

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- ■ **Lyondell**: Recognizing that its current profitability was poor, Lyondell embarked on a strategy to cut costs, expand production in more cost-efficient facilities, and explore strategic partnerships.[82] Lyondell's business strategy was wholly consistent with a cartel operating in the background. Simply stated, Lyondell would have done better, not worse, by being able to artificially increase prices in the market.

(37)   It is evident that, regardless of apparent differences in internal business models, all participants' profit-maximizing strategies would have benefited from artificially inflated prices.

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[82]   Elzinga report at 51.

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3. My econometric model reflects widely recognized and well-established best practices

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3.1. Introduction

(38)   I have carefully reviewed and considered Dr. Ugone's criticisms of my econometric model. None of them cause me to question the validity of the methodology I used or the way I applied it to the facts of this case. To summarize, I built an econometric model to account for the relevant supply and demand factors influencing prices. I followed best practices in the relevant academic literature. These best practices are the same ones used in other models that have been accepted by the courts.[83] Standard diagnostics for a forecasting model confirmed that my model was performing well.[84]

3.2. My usage of weighted median prices is standard

(39)   Dr. Ugone's assertion that I should not have used a representative industry-wide price lacks any academic support. Indeed, because aggregated prices are "a common way of showing price trend over time" and a good "measure of central tendency," Dr. Elzinga examined weighted average prices as a measure of prices over time.[85] The use of industry-wide prices is standard practice.[86]

(40)   Moreover, Plaintiffs have alleged an industry-wide conspiracy affecting pricing. As such, using a monthly weighted median price reliably captures those industry-wide allegations. Dr. Ugone's arguments thus attack a straw man. I never claimed that there was a single price in the benchmark product categories, nor did I assert that I would expect to see a single price. To the contrary, I previously explained in detail how and why I chose to use monthly weighted median

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[83]   *See, e.g., In Re DRAM Antitrust Litigation,* 608 F.Supp.2d 1166 (N. D. Cal. 2009); *In re Linerboard Antitrust Litigation,* 497 F.Supp.2d 666 (E.D.P.A. 2007); and *In re Vitamins Antitrust Litigation*, 305 F. Supp. 100 (D.D.C., 2004).

[84]   These diagnostics showed that my model predicted nonconspiracy prices well and had a low residual autocorrelation.

[85]   Elzinga report at 65, Exhibit 1; Elzinga deposition at 382:19-383:10. Dr. Elzinga examined average prices while I examined median prices. I preferred to study median prices in this case because the median is less sensitive to transactions at extremely high or extremely low prices.

[86]   Generally speaking, it is standard within the field of economics to look at a single representative price even when transactions occur at different prices. For example, Craig Peters analyzed the effect of airline mergers by looking at changes in route-level average airline fares. He did so despite the fact that people obviously pay different fares to fly. "Price is computed as a passenger-weighted average of all fares reported" for each airline-itinerary combination. Craig Peters, "Evaluating the Performance of Merger Simulation: Evidence from the U.S. Airline Industry," 49 *Journal of Law and Economics* (2006) at 631. In addition, experts for both the Plaintiffs and Defendants in the In Re DRAM Antitrust Litigation relied upon a single representative price for portions of their damage analyses. Rebuttal Expert Report of Halbert L. White, Jr., Ph.D. (May 2, 2008).

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prices in my econometric model, and how my transaction-level model accounts for the price dispersion that Dr. Ugone highlights.[87]

(41)   Dr. Ugone also ignores evidence that suggests that prices moved together and were driven by a common structure.[88] As noted above, observed differences in the prices paid by different purchasers do not indicate that those prices were determined by competition rather than a conspiracy.

(42)   Dr. Ugone's discussion regarding the absence of a "single price" fails to either reference or acknowledge the product price lists and price increase announcements identified by this Court as evidence of a baseline price.[89] Moreover, Dr. Ugone failed to reference or acknowledge Defendant testimony detailing this baseline pricing structure, which demonstrates that, while the actual price paid by a particular Plaintiff to a particular Defendant may have differed based on individual negotiation skills and other factors, it was the practice of the Defendants to use the price announcements as a baseline price for those negotiations.[90]

(43)   Furthermore, the price announcements themselves illustrate how broad-based market price levels were driven by common trends, even if prices to individual customers may have differed due to individual negotiations. For instance, a representative Dow price announcement reads:

> Effective January 1, 2000 Dow Polyurethanes will be increasing all off-schedule prices for VORANOL* Polyols, Copolymers and VORANTE* TDI by $0.03/pound. Throughout the year we have seen a continued increase in energy and raw material costs [...] This pricing action applies to polyols and TDI used in all market segments and all end-use applications.[91]

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[87]   Raiff report at ¶ 287 ("This second part accounted for any effects not explicitly accounted for by the model, such as idiosyncratic factors' effect on price. Such factors include (but are not necessarily limited to) the identity of the customer and the nature of the relationship (and contract, if any) between the customer and the vendor"); Raiff deposition at 476 (explaining that my second stage would control for "idiosyncratic effects.").

[88]   Dr. Elzinga wrote that with some exceptions, to the extent that prices moved over time, "they move together." Elzinga report at 64–65.

[89]   Memorandum and Order on Class Certification (for polyether polyols) at 19–20, *In re Urethane Antitrust Litigation*, MDL No. 1616 (D. Kan.) (July 28, 2008).

[90]   *See, e.g.,* Deposition of Wayne LeSage at 278:16-278:20 (September 30, 2010) ("Q. Is it – would it be fair to say that the – a price increase is essentially a starting point for a negotiation with a customer on a price? A. Certainly during this period of time they always were a starting point I would say."); and Deposition of David Freidinger (hereinafter Freidinger deposition) at 24:17-25:2 (Apr. 7, 2010) ("Q. Okay. For your off-list price customers, did the price increase letter serve the function of being the baseline for your negotiations? A. Yes. It established an amount that we sought to achieve with the price increases. Typically, and obviously not more than that, it was kind of the baseline at that point unless we announced another price increase or other discussions had occurred.").

[91]   FSI_000000230.

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(44)   While the effectiveness of price announcements may have varied throughout the conduct period and between customers,[92] they were designed to improve business margins more generally.[93] This pricing structure is consistent with my understanding of how the conspiracy operated and with my methodological choice to use a two-step model.[94]

(45)   Finally, more than mere "visual inspection" would be necessary to reach Dr. Ugone's conclusion that my use of weighted median prices is incorrect.[95] When prices differ but move together over time, the "economic content" about their movement can be preserved with a representative price. Suppose, for example, that the prices of two products move together but the levels of the prices differ. A representative price will capture the movements in the prices of the underlying products quite well. See Figure 2.

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[92]   *See, e.g.,* Freidinger deposition at 25:3-9 ("Q. And what would determine the success of that negotiation or not, what factors? A. There were many, many factors that went into those negotiations. Obviously they were done on a BASF to customer basis, on an individual customer basis, and it was a function of many components"). *See also* Deposition of John Phelps at 463:1-463:17 (Sept. 24, 2009)("Q. When you testified about those price increases, were you distinguishing between price increase announcements and actual net price increases paid by customers…A. My understanding to his questions were about the specific announcement…Q. And not necessarily in the end what the customer actually paid? A. Correct. Q. And that amount might be negotiated on a customer-by-customer basis, correct? […] A. Yes").

[93]   *See, e.g.,* Deposition of William Long at 38:6-16 (Oct. 5, 2010) ("Q. Okay. Okay. So still focusing on the time period when you were vice president of North America, what were the factors that you took into account in determining whether or not to increase prices for polyurethanes? A. From my standpoint, it was a need to maintain or improve margins. Q. Okay. A. I mean, I didn't – I didn't know the customers well enough. I mean, I was not a sales person").

[94]   *See* Raiff report at ¶¶ 201–06.

[95]   *See* Ugone report at ¶ 4.

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Figure 2 Hypothetical individual products' prices compared to benchmark product category price
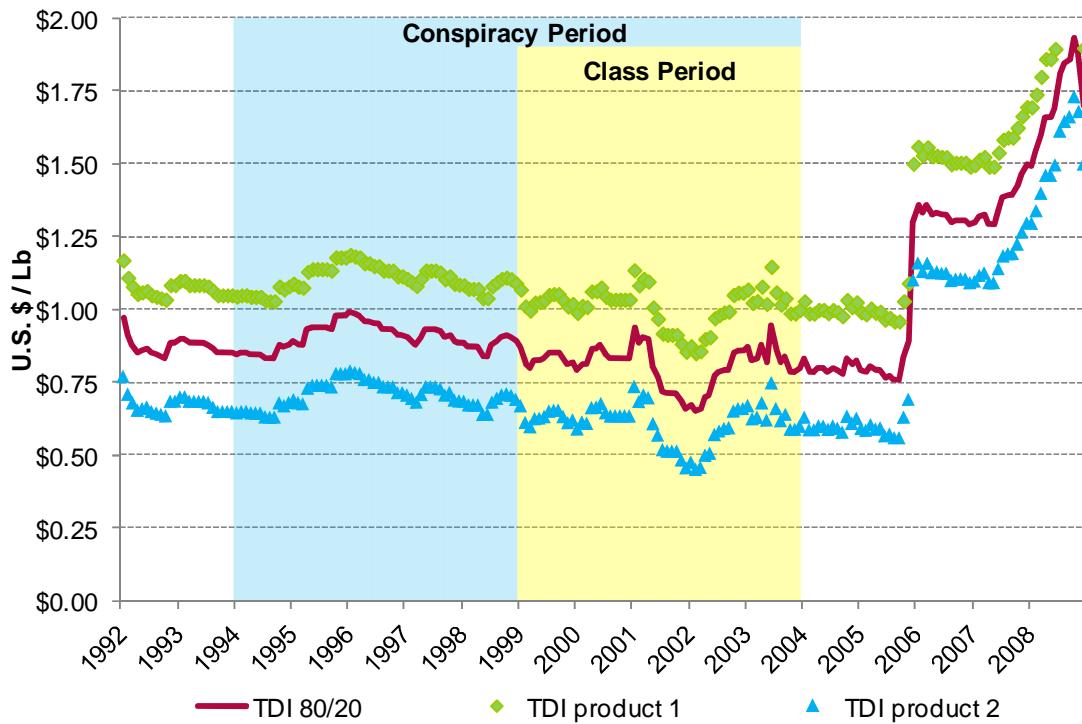
(46) It should be clear from Figure 2 that the prices of product 1 and product 2 track the price of TDI 80/20 closely. My point here is not that the actual transaction data are quite as simple as the hypothetical data shown in Figure 2. Rather, it is to illustrate that Dr. Ugone has no basis to categorically assert that movements in benchmark product category prices do not capture movements in individual transaction prices. Regardless, as I will now show below, my econometric model accurately accounts for the price dispersion seen across individual transactions.

3.2.1. My transaction-level model accounts for price dispersion

(47) Dr. Ugone neglects to acknowledge the fact that the second step of my econometric model is explicitly designed to account for the price dispersion he identifies. As I have explained, in the first step of my econometric model, I model industry-wide prices. In the second step, I specifically account for the distribution of individual transaction prices. For the data in Figure 2, the second step of my econometric model would add $0.20 per pound to the TDI 80/20 benchmark category price to predict the price of product 1. Likewise, it would subtract $0.20 from the TDI 80/20 benchmark category price to predict the price of product 2.

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(48)   Indeed, the product-specific regressions contained in the second step specifically account for the
         exact information that Dr. Ugone claims is "inappropriately mask[ed]" by my analysis. My
         transaction-level but-for prices directly embody these individualized factors.[96] The second step of
         my econometric model accounts for 88% of the variation in the underlying transaction prices of
         all TDI products. Similarly, I account for 92% of the variation in transaction prices of all MDI
         products and 96% of the variation in transaction prices of all polyols products.[97]

(49)   Figure 3 and Figure 4 are further evidence that, contrary to Dr. Ugone's allegation, the two steps
         of my econometric model act in combination to accurately account for the distribution of prices.[98]
         Specifically, Figure 3 shows the actual transaction prices for the largest Direct Action Plaintiff
         buyer of Dow's largest TDI product and Figure 4 shows the actual transaction prices for the
         largest Direct Action Plaintiff of Dow's largest MDI product. These actual transaction prices
         closely track the benchmark product category actual prices but are generally above them.
         Likewise, the but-for transaction prices closely track the benchmark product category but-for
         prices but are also above them. Also note that where the actual transaction price is far above the
         benchmark product category median price, so too is the but-for transaction price.

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[96]   Other factors that may impact individual transaction prices include, but are not limited to, customer size, quantity,
       delivery terms, customer needs, and other customer- and product-specific issues.

[97]   I also account for 87% of the variation of TDI 80/20 products, 94% of the variation of polymeric MDI products,
       and 98% of the variation of conventional flexible slab polyol products.

[98]   *See* Ugone report at ¶ 43.

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Figure 3 Leggett & Platt Voranate T-80 actual and but-for transaction prices

Page 26
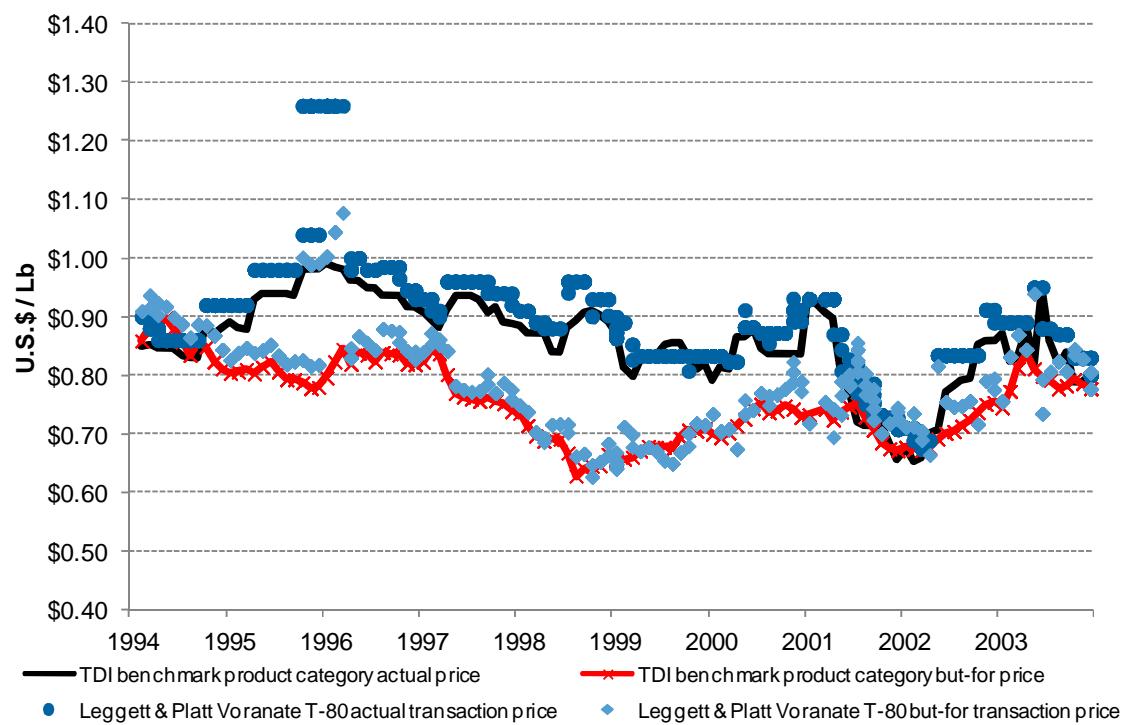
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Figure 4 Foam Supplies Papi 27 actual and but-for transaction prices
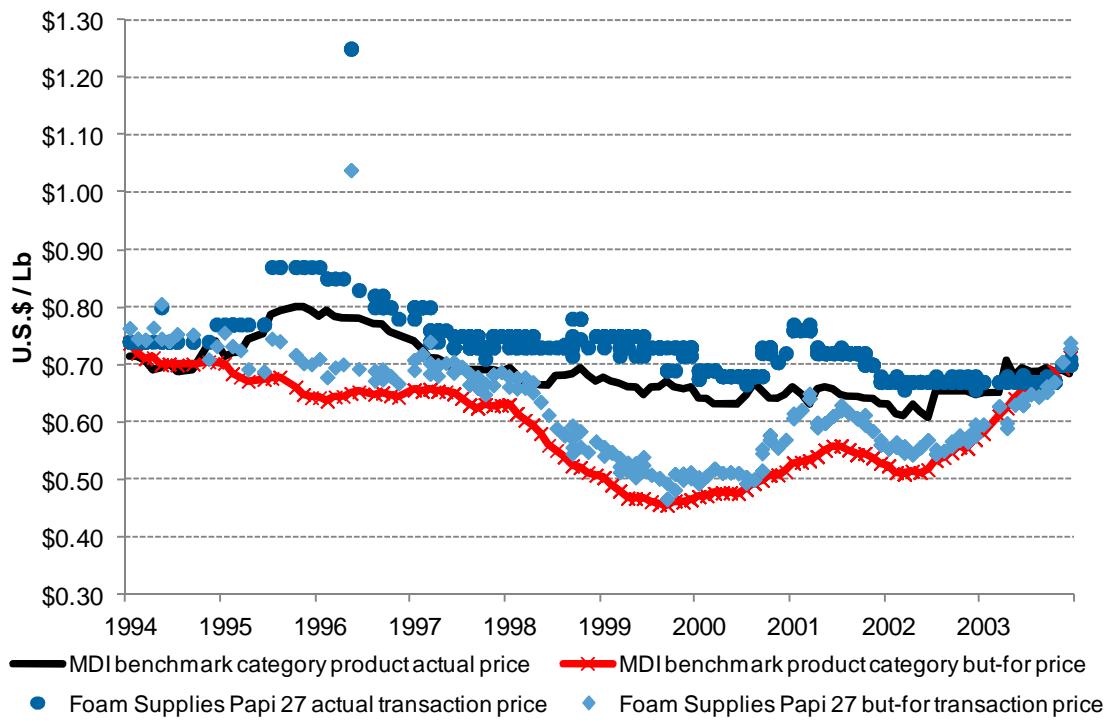
(50)   Figure 5 shows the relationship between actual and but-for prices by illustrating how close each transaction price is to the median benchmark product category price. For instance, transactions where the actual prices are more than 5.0% above the benchmark product category median price are on average 16.2% above it. Similarly, those transaction but-for prices are on average 16.0% above the but-for benchmark product category price. Therefore, on average, the transaction-level step of my econometric model accurately accounts for idiosyncratic pricing differences across, among other things, Defendants, Direct Action Plaintiffs, and products. Contrary to Dr. Ugone's allegation, this table shows that the two steps of my econometric model act in combination to accurately account for the distribution of prices.[99]

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Figure 5 Proximity of transaction price to benchmark product category price

Proximity of transaction price to benchmark product category actual price	Average difference from benchmark product category actual price	Average difference from benchmark product category but-for price
<-5%	-8.9%	-8.0%
+/-5%	0.4%	0.3%
>5%	16.2%	16.0%

(51)   Figure 6 shows the underlying data that are summarized in Figure 5. Figure 6 once again demonstrates that contrary to Dr. Ugone's allegation, both steps of my econometric model act in combination to accurately account for the distribution of prices.[100] The horizontal (left-right) axis measures how close each transaction price is to the benchmark product category price. A value of $0.20 means the transaction price is $0.20 above the corresponding benchmark product category price. The vertical (up-down) axis measures how close each transaction but-for price is to the benchmark product category but-for price. A value of $0.20 means the but-for transaction price is $0.20 above the corresponding benchmark product category but-for price.

(52)   The black line on the graph is a 45-degree line. When a transaction falls on the 45-degree line, if the actual transaction price was $0.20 above the benchmark product category price, then the but-for price for that transaction would be $0.20 above the benchmark product category but-for price. Because most prices are close to the 45-degree line, the data are indicating that there is a close, but not always one-to-one, relationship between benchmark product category prices and transaction prices.

(53)   Hence, Dr. Ugone's claim that my "damages are predicated upon a flawed approach that collapses individual transaction prices into a single monthly weighted median price," which "fails to provide important economic content contained in the individual transaction prices," is wrong.[101]

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[100]   *See, e.g.*, Ugone report at ¶¶ 43, 48.
[101]   Ugone report at ¶ 48.

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Figure 6 Relationship of actual and but-for differences between individual transaction and benchmark product category price
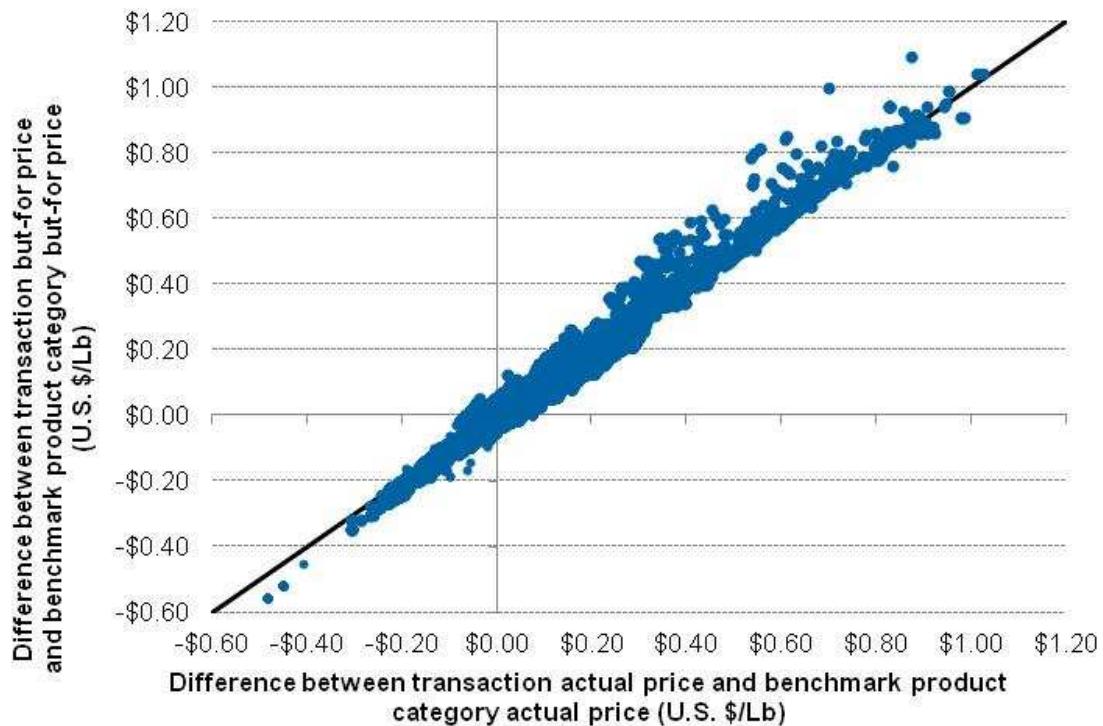
3.3. My model relies upon appropriate supply and demand variables

(54)   As I explained at length in my initial report and in my deposition, in my model I have carefully accounted for a wide range of demand and supply factors.[102]   Nevertheless, in his deposition, Dr. Ugone contended that in my model I have failed to properly account for two important variables: capacity and demand.[103]   I address each in turn.

(55)   With regard to capacity, Dr. Ugone incorrectly claimed that I failed to explain why I chose not to use it as a variable.[104]   In fact, I thoroughly explained my reasoning in both my initial report and deposition.[105]   I accounted for the changes in the industry in 2005. Dr. Ugone conceded I did so

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[102]   *See* Raiff report ¶¶ 240-82; Raiff deposition at 429:1–449:10.

[103]   Ugone deposition at 625:11-640:13.

[104]   Ugone deposition at 638:5–19.

[105]   *See* Raiff report at ¶¶ 241–42; Raiff deposition at 68:21–70:1.

        Q: You said you wouldn't control for capacity, and why not?

        A. I said I wouldn't put capacity in the model.

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properly.[106] After accounting for the changes in the industry in 2005 and beyond, a reliable, simpler, and better approach in this case is to account for capacity by including factors that likely influenced capacity decisions. Because capacity is related to supply and demand variables, I have already accounted for it in my econometric model.

(56)   However, to further confirm that my model properly accounts for capacity, I have also examined the effect of including it in my model.[107] The inclusion of capacity in my model leaves my estimated overcharges unchanged.

(57)   Next, with regard to demand, Dr. Ugone testified that "there's a wide number of ultimate end products for these products that are inputs and I don't see indications that those were considered in the modeling process."[108] As with capacity, I engaged in a thorough evaluation of polyether polyol products demand to determine which variables should be included in my econometric model.[109] I included industrial production indices reported by the Federal Reserve Board for appliances, carpeting, and furniture; total motor vehicle assemblies to capture demand in the auto industry; and new privately owned housing units started to capture demand in the construction sector.[110] Dr. Ugone failed to show that adding any additional demand variable to my econometric model would significantly change my results. In response to Dr. Ugone's deposition testimony, I found that including the durable consumption goods industrial production index does not change my results.[111]

Q. And why not?

A. You wouldn't -- in a forecasting method -- in a forecasting model where one is trying to predict the evolution of prices through time, it is inappropriate to put in that model a variable that may have been tainted or affected by the conspiratorial conduct. And there are a number of reasons in this matter as to why one might think that conspiratorial conduct could have affected capacity.

Q. And when you say capacity, are you talking about total available capacity, that is, plants in the ground or are you talking about capacity utilization?

A. I'm speaking to both.

Q. Both. And you say you wouldn't utilize either one of those because they were tainted by conspiracy?

A. When you are doing a forecasting approach to damages that we've done in this matter, it is very important that you do not include in the -- as you defined earlier, the independent variables, you do not want any of the independent variables to have potentially been affected by the conspiratorial conduct in question.

[106] Ugone deposition at 628-29, 646-47.

[107] I reiterate that I regard the inclusion of capacity as inappropriate inasmuch as it was likely influenced by the conspiracy. *See, e.g.*, Raiff deposition at 454:12-457:10.

[108] Ugone deposition at 638:25–639:3.

[109] I discuss this, among other places, in Sections 5.2 and 6.3 of my initial report.

[110] Raiff report at ¶ 259.

[111] The durable consumption goods industrial production index is a broader measure of industrial production than the industrial production series I have already included in my econometric model.

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(58)   These analyses corroborate my results and provide further evidence that my econometric model relies upon appropriate demand and supply variables.

(59)   My econometric model also accounts for demand effects from the relevant demand segments indirectly. Those demand effects are incorporated via their relationship with the supply and demand variables that are already in the model. These variables not only account for their own effects, but also proxy for other variables' effects.[112] For the same reasons, my econometric model accounts for the alleged foamer conspiracy, whose effects would be accounted for by my demand variables.[113]

3.4. My econometric model uses an appropriate estimation technique

(60)   Dr. Ugone suggests that I should not have used both economics and statistics to construct my econometric model.[114] Specifically, Dr. Ugone's criticizes me for using what he calls "inconsistent" approaches to incorporate variables in my econometric model. [115] To the contrary, the approaches I used were complementary.

(61)   The objective of my econometric model is to predict prices. With this objective in mind, I studied the urethanes industry. I identified the key economic factors for predicting urethane prices.[116] This ensured that my econometric model was consistent with the economic realities of the industry.

(62)   My knowledge of the urethanes industry indicated that certain variables, while not key drivers of prices, could potentially be relevant and improve my predictions of but-for prices. To incorporate these variables, I employed a standard statistical procedure to identify those variables that improved the predictive performance of my econometric model. The procedure relies on a widely-used measure called AIC.[117] Using AIC allowed me to include additional variables to improve predictions, while at the same time avoiding the problem of "overfitting" the model to the data – that is, including so many variables that the predictive performance of the model was

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[112] *See* Section 3.6 for a full explanation, and paragraph (95) in particular.

[113] Dr. Ugone does not say how I should have accounted for the alleged foamer conspiracy.

[114] *See* Ugone report at ¶ 163, 172–79.

[115] Ugone report at ¶ 172.

[116] My models (referring separately to TDI 80/20, PMDI, and CFS polyols) include at least one cost variable and two demand variables to properly account for key price drivers.

[117] The Akaike Information Criterion (hereinafter AIC) is designed to reduce prediction errors. *See, e.g.,* Hirotugu Akaike, "A New Look at the Statistical Model Identification," *IEEE Transactions on Automatic Control* 19, no. 6 (1974): 716–23; Rieta Shibata, "Asymptotically Efficient Selection of the Order of the Model for Estimating Parameters of a Linear Process," *Annals of Statistics* 8, no. 1 (1980): 147–64.

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diminished. AIC is designed to strike a balance between predictive performance and the problem of overfitting.

(63)   Dr. Ugone asserts, "The AIC approach to independent variable selection generally is used to allow (statistical) choice among <u>all</u> variables in order to generate the best relative fit using the least number of variables."[118] However, the literature is quite clear regarding the importance of subject matter knowledge in econometric model building. As one textbook's authors emphasize, "the single most important tool in selecting a subset of variables is the analyst's knowledge of the area under study and of each of the variables."[119] The authors then explain why certain variables may be required to be included in the model.[120]

(64)   Dr. Ugone performs two exercises that he apparently believes say something about the reliability of my econometric model. These only serve to illustrate the incoherence of Dr. Ugone's approach to criticizing my econometric model. First, Dr. Ugone uses only a statistical measure (AIC) to select the variables to include in a model. Second, Dr. Ugone estimates a different model that includes no variables other than the ones my industry study identified as key drivers of price.

(65)   To the extent that Dr. Ugone believes that his first exercise, estimating a model that uses only AIC to select variables, is in any way an indictment of the reliability of the AIC criterion or my modeling strategy, he is wrong. To the contrary, it is an indictment of his poor implementation of accepted econometric modeling techniques. In the language of the very textbook he cited, Dr. Ugone's results contained in his Exhibit 61 are "unexplainable" given the economics of the industry.[121] Stated simply, his results are unreliable because his exercise omits key economic factors. The variables that are selected contain neither demand variables[122] nor key cost drivers for extended periods of time.[123] From these models, Dr. Ugone incorrectly suggests that my analysis is deficient in some manner.[124]

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[118]   Ugone report at ¶ 175 (emphasis in original).

[119]   *See* section 10.2.3 in Sanford Weisberg, *Applied Linear Regression*, 3rd ed. (Hoboken: John Wiley & Sons, 2005).

[120]   *Id.*

[121]   "[T]he problems of pretest estimation and stepwise model building also pose some risk of ultimately misspecifying the model. To cite one unfortunately common example, the statistics involved often produce unexplainable lag structures in dynamic models with many lags of the dependent or independent variables." William H. Greene, *Econometric Analysis*, 7th ed. (Upper Saddle River, NJ: Prentice Hall, 2007) at 139.

[122]   Ugone report at Exhibit 61 at 11; *see also* Ugone report at Exhibit 61 at 13 (no demand variables before 2005).

[123]   Ugone report at Exhibit 61 at 12.

[124]   As discussed in Section 3.4.1, elsewhere in his report Dr. Ugone estimated and reported a model that intentionally omitted an important demand variable.

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(66)   Dr. Ugone's second exercise performs the corollary of the mistake he made earlier. Instead of allowing AIC to select from *all* of the variables, he then allows it to select from *none*. Dr. Ugone reports the results of using only my key supply and demand variables to predict prices.[125] By doing so, he fails to account for remaining pricing dynamics that exist in the data. The importance of these remaining pricing dynamics is indicated by the fact that Dr. Ugone's predictions are markedly different from mine. Because Dr. Ugone failed to account for these remaining pricing dynamics, his results are unreliable and say nothing about the soundness of my results.

(67)   Moreover, Dr. Ugone, after reviewing my econometric model, had an opportunity to perform his own analysis by using his own set of preferred key supply and demand variables and then show how the choice between our sets had an impact on the results. Dr. Ugone chose not to do so.

(68)   Relatedly, Dr. Ugone also criticizes me for purportedly using a stepwise method and cited a footnote in a book review and a single textbook for support.[126] Dr. Ugone's criticism has no merit. Dr. Ugone does not appear to fully understand the purpose and mechanics of the econometric techniques I employ. By no means can my first step, identifying key supply and demand variables through study of the industry, reasonably be characterized as a stepwise statistical procedure.

(69)   As defined in standard textbooks, a traditional stepwise regression uses statistical significance, as measured by statistics such as a t-statistic or an F-statistic, to determine whether a variable should be included or not.[127] I would note, however, that it is well known that the use of statistical significance to select variables might generate biased coefficient estimates and biased statistical tests.[128] In my approach, I do not use statistical significance to select my variables.

3.4.1. Dr. Ugone incorrectly deletes economically important demand variables from the model

(70)   Apparently in an effort to show that results are changed, and despite his criticism that my model failed to fully account for demand, Dr. Ugone proceeds to estimate a model of PMDI prices in which he intentionally omits a demand variable (the industrial production of appliances,

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[125] Ugone report at ¶ 174; Ugone report at Exhibit 60.

[126] Ugone report at ¶ 179.

[127] *See, e.g.,* David Ray Anderson, Dennis J. Sweeny, and Thomas A. William, *Statistics for Business and Economics*, 10th ed. (Mason, OH: Thompson South-Western, 2008) at 739–43.

[128] I do not need to worry about biased coefficient estimates or biased statistical tests because my objective is to generate the most accurate prediction for prices absent Defendants' conspiracy. *See* Section 3.6.

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carpeting, and furniture).[129] All this shows is that, as the economics suggests, the omitted variable is important to the predictive performance of my model. Furthermore, Dr. Ugone's usage of such a "stepwise" analysis is inconsistent with Dr. Ugone's claim in the very next section of his report that the technique is "generally recognized" "to be avoided."[130]

3.5. Dr. Ugone's modifications to my model are inappropriate

(71)   Dr. Ugone makes a series of other modifications to my model in what he refers to as "sensitivity" tests. Namely, Dr. Ugone (a) uses disaggregated data, (b) uses different data, and (c) arbitrarily modifies the time periods. I have considered each of these modifications and concluded that they are inappropriate and uninformative.

3.5.1. Dr. Ugone's usage of disaggregated data results in a less reliable and comprehensive alternative to my econometric model

(72)   Dr. Ugone notes that when he generates median price lines for individual Defendants, and then estimates the first step of my model separately on each of the five Defendants' price lines, he obtains different damages results.[131] This is not surprising, nor does it undermine the results of my econometric model. By modeling the prices of the benchmark category products separately for each Defendant, Dr. Ugone inappropriately introduces artificial variability into the benchmark product category prices. Because each Defendant's benchmark product category price is a noisy measure of the prevailing industry-wide benchmark product category price, the Defendant-specific pricing analysis set forth by Dr. Ugone obscures the underlying relationship between the supply and demand variables and industry-wide benchmark product category prices.[132]

(73)   As a matter of econometrics, the usage of disaggregated data might cause at least two problems: (1) it might introduce artificial variability into the model and (2) it might make it impossible to estimate the model because of insufficient data. Dr. Ugone, in fact, recognizes these problems when he admits that he cannot estimate claimed damages for certain Defendants and certain products "due to a lack of data" and "very high variability."[133]

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[129] Ugone report at ¶ 169.

[130] Specifically, he criticizes stepwise regression in Section XIV.B at ¶ 179, yet he relies on it in Section XIII.E at ¶ 169.

[131] Ugone report at ¶ 4(i).

[132] *See* Ugone report at ¶ 182, Ugone report at Exhibit 62.

[133] Ugone report at ¶ 182 (notes to Table 1). The first step in my econometric model, which analyzes industry-wide benchmark product category prices, appropriately accounts for the systematic variation in Defendant-specific price lines. The second step in my econometric model, which analyzes individual transactions, accounts for the variation

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(74)   Below are two illustrative figures. Figure 7 shows a price line for which Dr. Ugone estimates a model; Figure 8 shows Defendant-specific prices for which Dr. Ugone does not estimate a model.

(75)   Figure 7 shows the industry-wide price of CFS polyols in blue and Bayer's monthly median price for CFS polyols in green. It shows that Bayer's median prices track the industry-wide prices rather closely, except in 1992–1993. Figure 7 also shows that in some months, the Bayer median price for CFS polyols is substantially higher or lower than the industry-wide price for CFS polyols. For instance, in February 1994, the Bayer median price is above $1.00 when the industry-wide median price is under $0.50. In 2006–2007, there are a few months in which the Bayer median price is noticeably below the industry-wide median price. These deviations from the industry-wide median prices are unusual, and from a modeling perspective, it is unsurprising that the model results are sensitive to such deviations.[134]

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that causes each Defendant's specific price line to differ from the industry-wide price line.

[134]   These unusual prices are likely to behave in the same way as outliers would. It is well known in the literature that outliers might affect regression results.

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Figure 7 Bayer and industry-wide CFS polyols prices
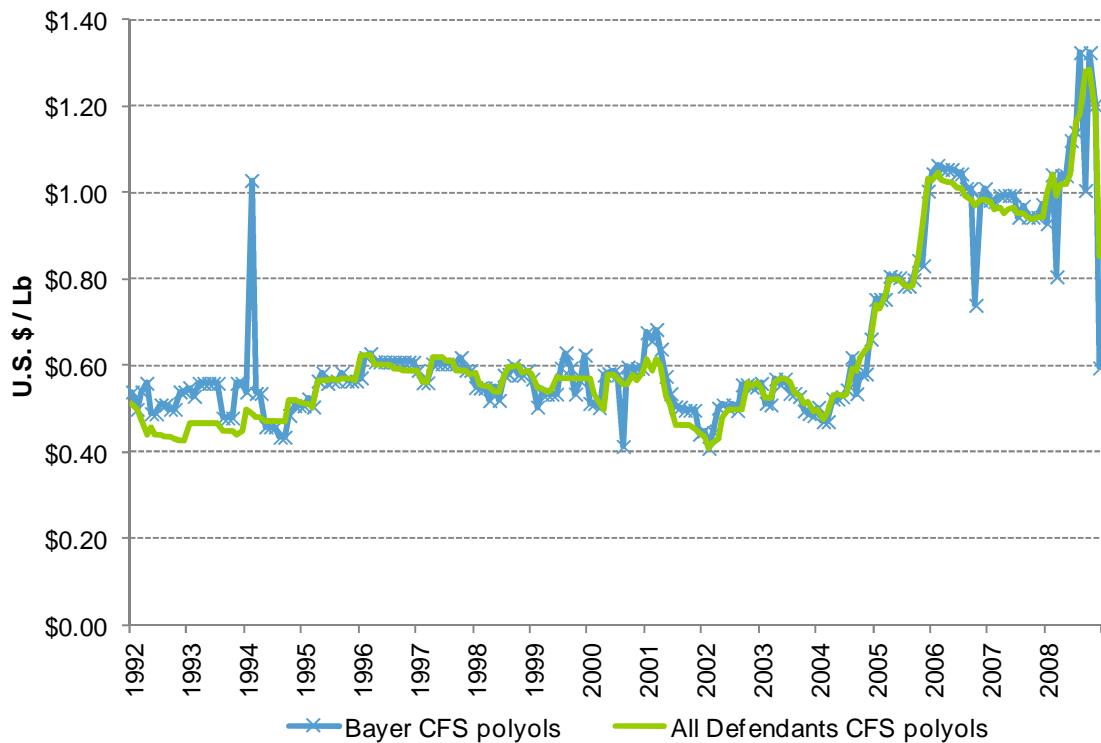
(76)   Figure 8 shows that for Defendants Huntsman and Lyondell, there is insufficient data to estimate the first step of my model for CFS Polyols and TDI by Defendant. Therefore, Dr. Ugone's proposed approach would fail to provide damages estimates for some of the Defendants.

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Figure 8 Defendant-specific median prices with insufficient data
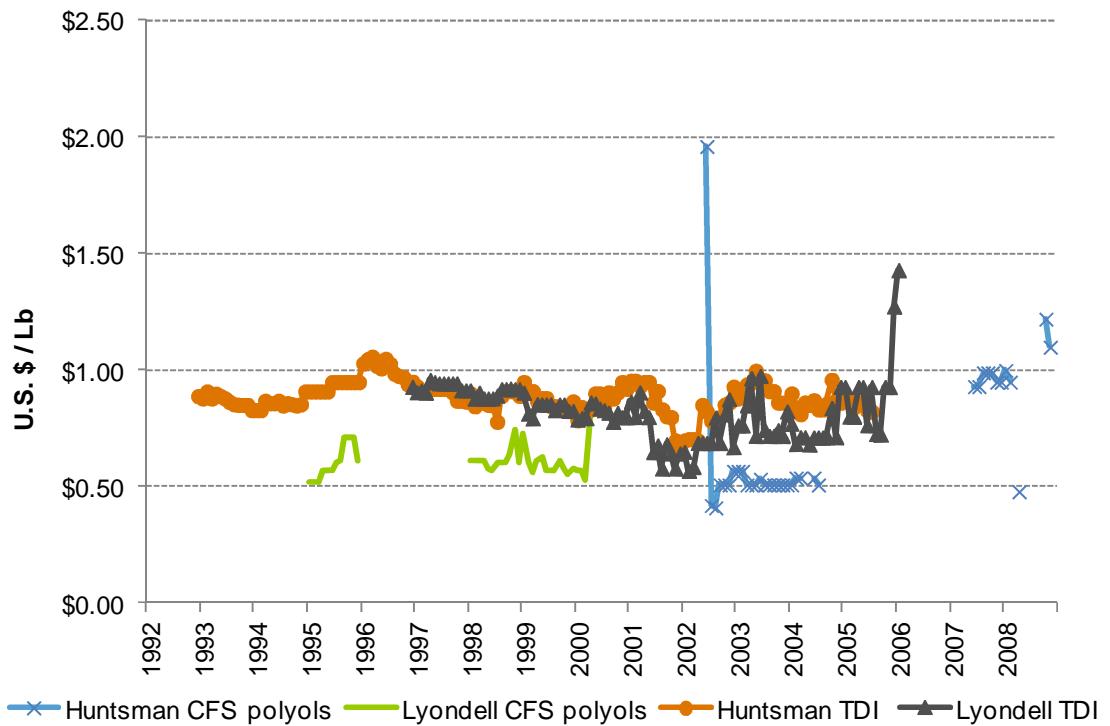
3.5.2. Dr. Ugone's transaction-level models corroborate my results

(77)   Dr. Ugone observes that my transaction-level model provides different results depending on which dataset is used and suggests that this somehow "casts doubt on the reliability" of my model.[135] This is incorrect. Dr. Ugone's analyses, when examined in their totality, only demonstrate that my results are robust.

(78)   Dr. Ugone performs two analyses on my transaction-level model.[136] In the first analysis, Dr. Ugone estimates my transaction-level model on data for all Class Plaintiffs and Direct Action Plaintiffs. This is counterintuitive and inappropriate. The specific purpose of my transaction-level model is to arrive at transaction-specific overcharges for the Direct Action Plaintiffs. Including the Class Plaintiffs' data in the transaction-level model obscures the relationship between Direct Action Plaintiffs' transaction prices and industry-wide prices.

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[135]   Ugone report at ¶ 198.
[136]   Ugone report at ¶ 197.

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(79)   Dr. Ugone only performs his analysis for two of the benchmark products, TDI 80/20 and PMDI, and does not perform his sensitivity analysis for CFS polyols. Dr. Ugone claims that there are "software constraints" that prevent him from producing results for CFS polyols using the combined Class and Direct Action Plaintiff data.[137] I do not understand Dr. Ugone's "software constraints" explanation. My team is able to perform Dr. Ugone's sensitivity analysis for CFS polyols.

(80)   In the second analysis (once again only for two of three benchmark products), Dr. Ugone estimates my transaction-level model separately for each Direct Action Plaintiff. However, he reports the effects on damages for only one of the 11 Direct Action Plaintiffs. I performed his analysis for all three benchmark products (rather than just two) and for all 11 Direct Action Plaintiffs (rather than just one).[138] Overall the damages are consistent with mine.

(81)   I find that the CFS polyols damages for Woodbridge, the only Direct Action Plaintiff for whom Dr. Ugone reports results, increase in both of Dr. Ugone's analyses. Specifically, when using the combined Class and Direct Action Plaintiff datasets, overcharges for CFS polyols increase from 7.8% to 9.4% in the class period, and increase from 7.3% to 8.6% in the conspiracy period. When the transaction-level model is estimated for CFS polyols using the purchases made by just Woodbridge, the damages for Woodbridge increase from 7.8% to 8.0% in the class period and increase from 7.3% to 7.4% in the conspiracy period.

(82)   When using Class and Direct Action Plaintiff data combined, overall damages decrease by only 1.25% for the class period and by only 3.33% for the conspiracy period. Moreover, when estimating the transaction-level model for each individual Direct Action Plaintiff, overall damages decrease by only 1.25% for the class period and by only 4.11% for the conspiracy period. The damages for each of these analyses are shown in Figure 9.

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[137]   *See* Ugone report at n. 355.

[138]   Dr. Ugone provides no explanation as to why he excludes CFS polyols from his second sensitivity.

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Figure 9 Comparison of damages for alternative transaction-level models

	Class Period			Conspiracy Period		
	Revised Raiff report damages	Ugone's Plaintiff-specific damages	Ugone's combined data damages	Revised Raiff report damages	Ugone's Plaintiff-specific damages	Ugone's combined data damages
TDI						
British Vita	$ 14,326,276	$ 14,376,980	$ 13,584,035	$ 28,587,162	$ 28,859,290	$ 26,947,469
Carpenter	$ 54,579,719	$ 58,723,413	$ 45,720,513	$102,909,975	$109,565,840	$ 88,256,489
Flexible Foam	$ 16,565,168	$ 16,592,686	$ 15,949,596	$ 37,839,899	$ 37,537,962	$ 36,077,419
Hickory Springs	$ 14,907,476	$ 12,978,210	$ 15,313,842	$ 31,779,886	$ 28,739,726	$ 31,393,685
Leggett & Platt	$ 13,308,025	$ 12,048,558	$ 13,313,427	$ 27,142,205	$ 24,558,911	$ 26,469,514
MarChem	$ 27,480	$ 30,894	$ 28,748	$ 58,657	$ 61,001	$ 52,521
Skypark	$ -	$ -	$ -	$ (17)	$ -	$ (17)
Woodbridge	$ 22,129,389	$ 21,125,948	$ 19,712,762	$ 44,251,218	$ 43,423,711	$ 41,224,322
MDI						
British Vita	$ 455,053	$ 124,020	$ 321,731	$ 641,462	$ 124,020	$ 493,785
Carpenter	$ 11,042,254	$ 12,441,774	$ 10,437,843	$ 15,883,695	$ 18,525,500	$ 14,986,373
Flexible Foam	$ 2,031,881	$ 2,076,840	$ 2,247,804	$ 2,081,972	$ 2,116,210	$ 2,297,778
Foam Supplies	$ 5,862,546	$ 5,835,892	$ 5,645,405	$ 9,182,294	$ 9,042,936	$ 8,692,637
Hickory Springs	$ 1,159,419	$ -	$ 1,145,900	$ 1,301,922	$ -	$ 1,294,027
Huber	$ 29,499,913	$ 29,499,913	$ 29,464,586	$ 33,269,403	$ 33,269,403	$ 33,385,690
Leggett & Platt	$ 4,238,517	$ 4,628,056	$ 4,955,906	$ 6,135,835	$ 6,861,303	$ 7,445,649
Lubrizol	$ 3,397,680	$ 3,317,290	$ 5,391,857	$ 6,050,438	$ 5,907,043	$ 8,337,394
MarChem	$ 6,308,889	$ 6,193,897	$ 6,614,843	$ 9,459,815	$ 9,112,353	$ 9,702,173
Skypark	$ 4,588,320	$ 3,851,091	$ 4,140,164	$ 6,721,285	$ 4,990,406	$ 5,876,260
Woodbridge	$ 2,702,727	$ 2,293,035	$ 1,962,992	$ 2,976,771	$ 2,320,615	$ 2,032,934
Polyols						
British Vita	$ 28,632,065	$ 28,279,838	$ 29,353,506	$ 39,339,660	$ 38,625,434	$ 40,003,446
Carpenter	$ 1,895,677	$ 1,765,412	$ 1,741,181	$ 11,940,958	$ 3,017,895	$ 8,363,300
Flexible Foam	$ 30,252,515	$ 30,830,549	$ 30,311,792	$ 46,251,584	$ 39,824,821	$ 45,158,333
Foam Supplies	$ 777,078	$ 140,753	$ 588,015	$ 1,201,031	$ 140,753	$ 918,788
Hickory Springs	$ 32,280,152	$ 31,388,029	$ 32,058,043	$ 48,080,609	$ 46,729,791	$ 47,565,153
Huber	$ 65,823	$ 54,057	$ 62,421	$ 65,822	$ 54,057	$ 62,421
Leggett & Platt	$ 27,512,963	$ 27,458,685	$ 27,570,762	$ 39,754,016	$ 39,590,528	$ 39,506,061
MarChem	$ 2,717,755	$ 2,716,145	$ 2,195,625	$ 4,540,390	$ 3,507,425	$ 3,663,749
Skypark	$ 2,751,749	$ -	$ 2,387,200	$ 4,094,779	$ -	$ 3,626,982
Woodbridge	$ 37,132,339	$ 37,743,276	$ 44,286,899	$ 55,244,619	$ 54,935,918	$ 62,387,022
Total	**$371,148,848**	**$366,515,238**	**$366,507,399**	**$616,787,349**	**$591,442,855**	**$596,221,356**

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(83)   Ultimately, Dr. Ugone's analyses produce results very similar to mine. This shows that the second step of my econometric model captures the idiosyncratic differences amongst Defendants, Direct Action Plaintiffs, and products. Consequently, my transaction-level model is robust and reliable.

3.5.3. The 2004 data belong in the benchmark period

(84)   Dr. Ugone observes that my model results change if he omits 2004 data from the benchmark period.[139] The fact that the results change does not imply that my model is unreliable. It is expected that my model results could change if one omits 60% of the data between the end of the conspiracy and the developments in 2005 that had important structural ramifications for the industry.

(85)   The relevant question about 2004 is whether it is economically appropriate to include it in the benchmark or conspiracy period. For the reasons set forth below, I continue to believe that 2004 is more appropriately considered part of the benchmark period.

(86)   In light of Dr. Ugone's claims regarding my treatment of 2004 as part of the benchmark period, I did additional investigation regarding that period. What I have learned confirms that 2004 is more appropriately placed in the benchmark period.

(87)   As shown in Figures 60–62 of my initial report, my econometric model, with 2004 in the benchmark period, predicts prices from 2004–2008. I also tested and found that the average prediction errors in 2004 are not statistically different from zero. This is evidence that the pricing dynamics in 2004 are consistent with nonconspiratorial conduct.

(88)   Bayer's counsel confirmed my understanding that Bayer's participation in discussions about raising prices and industry conditions with competitors had ended by the end of 2003.[140] Bayer's counsel confirmed that Christian Buhse, a former Bayer employee who admitted to Bayer's counsel after the fact his involvement in discussions with competitors, had become nervous after government raids at Bayer in late 2002 related to the other chemical products, including rubber chemicals and ethylene propylene diene monomer (EPDM) and informed Marco Levi of Dow and Uwe Hartwig of BASF at a meeting at Hartwig's house that he would not participate in any further discussions with them regarding raising prices and industry conditions.[141] Following these

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[139] As I explained in my deposition, I was instructed by counsel to assume that the conspiracy ended by 2003 and created my models based on that instruction.

[140] *See* email from Jodi Trulove to Phil Proger (May 22, 2012).

[141] EPDM is a type of synthetic rubber.

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raids, there was increased emphasis on antitrust compliance at Bayer. In addition, as a result of a reorganization at Bayer effective early 2003, Mr. Buhse had less ultimate authority over pricing decisions than he had previously had, and it was more difficult for him to discuss the ability to raise polyether polyol products prices with competitors.

(89)   To my knowledge, none of the Defendants have ever claimed that price-fixing occurred in 2004. With this background, I looked at the evidence to determine whether it was consistent with this information. There are several additional pieces of evidence that further convince me that 2004 is more appropriately treated as part of the benchmark period.[142]

(90)   Bayer was, in fact, raided by government investigators twice in 2002 (for the rubber chemicals conspiracy in September 2002 and for the EPDM conspiracy in December 2002).[143] In early 2003, pursuant to an internal investigation, Bayer applied for and received immunity for its participation in cartels relating to butadiene rubber and emulsion styrene butadiene rubber (ESBR).[144] In addition, a number of other alleged participants in the polyether polyol products pricing discussions left their respective companies or polyurethanes positions by the end of 2003. Dow removed its head of the urethanes division, David Fischer, by December 2003.[145] Around the same time, Dow removed Bob Wood from his position and demoted Levi to a position in Europe.[146] At Bayer, Larry Stern, Lee Noble, Hans Kogelnik, Helmut von Hagen, and Reinhold Lang had all left Bayer by December 2003.[147] In addition, Tony Hankins of Huntsman left its urethanes division from April 2003 through March 2004.[148]

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[142]   I am aware of and have considered evidence of contacts among various executives and price increases in early 2004. After considering this and other evidence regarding 2004, I continue to believe that 2004 is appropriately considered in the benchmark period and not as part of the conspiracy period.

[143]   Rubber Chemicals Decision at ¶ 48; Ivan Lerner, "Plastic Additives Makers Under Global Antitrust Scrutiny," *Chemical Market Reporter* 263, no. 8 (2003), available at http://www.icis.com/Articles/2003/02/21/190732/plastic-additives-makers-under-global-antitrust-scrutiny.html; Ruling on Motions to Strike and For Summary Judgment; *In re Ethylene Diene Propylene Monomer Antitrust Litig.*, Civil Action No. 3:03md1542 (SRU).

[144]   Commission Decision of 29/11/2006, Case COMP/F/38.538 – Butadiene Rubber and Emulsion Styrene Butadiene Rubber. As a result of Bayer's disclosure, the European Commission raided the headquarters of other producers in these markets, including Dow, Enichem, and Shell. *Id*.

[145]   The record discloses that Dow also investigated Fischer for alleged collusive discussions with competitors. *See* Deposition of Lynn Schefsky (December 7, 2010) at 61-62.

[146]   Deposition of Charles Churet at 264:22-267:6 (Jan. 12, 2011).

[147]   Exhibit 4354; BCPUR0627219-223.

[148]   Deposition of Anthony Hankins at 26–31 (February 4, 2010).

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(91)   I also considered the possibility that if the conspiracy ended by September 2003, lingering effects of collusion may have run into 2004. My econometric model tells me that there were no lingering effects, as overcharges are zero at the end of 2003.[149]

3.6. Dr. Ugone inappropriately interprets my coefficient estimates and their statistical significance

(92)   Dr. Ugone asserts that in my regressions each independent variable has "an associated coefficient which captures the effect of a change in that independent variable on the dependent variable – namely, the monthly median price of PMDI, TDI 80/20, or CFS Polyols (keeping all other independent variables constant)." He then claims that my econometric results are "nonsensical" because the coefficients in my econometric models have "signs" that are inconsistent with economic theory and common sense.[150] However, Dr. Ugone's claim is premised on a fundamental misunderstanding of my models. In a forecasting model like the one I estimated, the coefficients do not measure, and were not meant to measure, the effect of individual variables.[151] In contrast, Dr. Ugone's assertion is relevant in a structural model in which the question of interest is: holding all else constant, what is the impact of an *individual* independent variable X on the dependent variable Y. Therefore, in structural models, the sign and magnitude of the independent variable coefficients matter as the researchers are trying to isolate the variables' individual impact.

(93)   On the other hand, the question of interest in a forecasting model like mine is: what is the *overall* impact of *all* of the independent variables X on the dependent variable Y. The literature recognizes that in a forecasting model the regression coefficients in combination can make

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[149]   While I have referred to Dr. Bernheim's very similar methodology in *Vitamins*, we came to different conclusions regarding lingering effects. That is not a methodological disagreement. Rather, the facts suggest that we both made appropriate decisions. In *Vitamins*, the conspiracy was well organized, highly sophisticated, and caused significant overcharges, which took some time to dissipate. *See, e.g.,* Bernheim *Vitamins* report at Figures 12-1, 12-2, 12-6, 12-12, 12-13. In this case, by contrast, my estimated overcharges are far smaller and the evidence is of a different character, which suggests to me that the conspiracy was not likely to exert the same type of lingering effect on urethanes prices.

[150]   Ugone report at ¶¶ 4(g), 168.

[151]   In his deposition, Dr. Ugone admitted that my view regarding the coefficients in a forecasting model is shared by other experts. Ugone deposition at 659:16–660:22 ("Q. Okay. You began that answer with a recognition that there was some debate about whether or not signs of coefficients matter in forecasting model; is that right? A. Some debate in the sense that I have heard other -- let's just say there's two different camps. There's a Dr. Raiff camp and let say there's a Dr. Ugone camp." […] "Q. Who are the leading authorities that you can think of that are in Dr. Raiff's camp? A. You know, I don't know if I want to talk about leading authorities, I've seen other – the world I'm in and the litigation world in terms of -- but I've seen other damage quantifiers take the position that Dr. Raiff has taken.").

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accurate predictions even in situations where data limitations render the coefficients not interpretable.[152,153]

(94)   This very issue was addressed in the *Linerboard* case. I quote below Dr. White's testimony before the Honorable Jan DuBois because it is informative and directly applicable here.

> [A]ll of these variables act together and they also act as proxies for things that are left out. So, even though one might think from a cause-and-effect standpoint that the sign should be negative, that forgets the fact that these variables are not only acting for themselves, but for other things left out that they might be correlated with, and of course they have to interact with all the other variables that are included at the same time. So, it's not appropriate to isolate attention on any one particular variable, it's like listening only to the oboe player when in fact what you care about is the ensemble. […]
>
> [L]et me suggest that what we're really listening to here is an alleged-conspiracy concerto and the role of the other players in this orchestra are to support our ability to measure that effect. The prediction that I come up with is one which takes into account all of these factors, but does not necessarily the factor such as wages and, so, it's important that they be there. But the particular sign that arises in making a prediction and in forming a prediction equation does not have to go in one direction or another as cause and effect might dictate, that's because when one is analyzing cause and effect the idea is that you . . . vary one thing, holding all other things constant. In the real world, all of these different influences vary together and, because you're not able to hold one thing constant, you can't guarantee that the sign on that one thing would be what you might expect.[154]

(95)   To give a tangible example of how variables can serve as a predictive proxy, consider industrial production, one of the variables in my model. Industrial production obviously relates to the strength of demand. At the same time, industrial production measures macroeconomic business

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[152]   James H. Stock and Mark W. Watson, *Introduction to Econometrics*, 3rd ed. (Boston: Addison Wesley, 2011) at 329 ("More generally, regression models can produce reliable forecasts, even if their coefficients have no causal interpretation. This recognition underlies much of the use of regression models for forecasting."); Halbert White, "Time-Series Estimation of the Effects of Natural Experiments," *Journal of Econometrics* 135, no. 1–2 at 527–66 (2006).

[153]   Such data limitations include omitted variables, misspecification of the functional form, measurement error, missing data, sample selection, simultaneous causality, and multicollinearity. *See, e.g., Introduction to Econometrics* at Chapter 6.7, 9.2, 9.3.

[154]   Daubert Hearing Testimony of Halbert White at 50–51, *In re Linerboard* (No. MDL 1261), July 2, 2007.

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conditions as well. Hence the variable industrial production serves as a predictive proxy for both demand and supply conditions.

(96)   In addition, Dr. Ugone claims that my econometric results are "nonsensical" because my models have some coefficients that are "not statistically significant."[155] I disagree.

(97)   Dr. Ugone's claim implies that one would want to exclude from a regression variables with statistically insignificant coefficients. As I explained in Section 3.4, such a practice is an element of the traditional stepwise regression, a practice that the literature has criticized.

(98)   Furthermore, for reasons similar to those described above regarding the interpretation of signs of coefficients, such a claim does not apply to my econometric model. While it may be natural for economists that are interested in interpreting and measuring the coefficients to ask whether a particular coefficient is statistically different from zero, that is not the question of interest for my analysis. Rather, because my objective is to predict prices, the question of interest is whether my predictions are accurate. I address this topic in Section 3.8.3.

3.7. Dr. Ugone failed to properly test the predictive performance of my model

(99)   Dr. Ugone estimates my model by using only pre-conspiracy data and reports that the model fails to predict prices in the post-conspiracy period. He also estimates my model using only post-conspiracy data and reports that the model fails to predict prices in the pre-conspiracy period. Dr. Ugone claims that the above sensitivities are evidence that my model is unreliable.[156] I disagree.

(100)   As I explained in Section 5.6 of my initial report, the urethanes industry went through restructuring and was impacted by natural disasters such as Hurricanes Katrina and Rita in the post-conspiracy period. It is therefore unsurprising that Dr. Ugone cannot predict prices in the post-conspiracy period by using only information from the pre-conspiracy period and vice versa. Dr. Ugone's sensitivity provides no evidence that my model is unreliable.

(101)   To build a reliable model that could use all available non-conspiratorial period data, I carefully accounted for the changes in the industry in my model by allowing the relationships between

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[155] Ugone report at ¶ 4(g).
[156] Ugone report at ¶ 118.

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polyether polyol products prices and demand and supply factors to be different in the post-conspiracy period.[157]

(102)   In Section 3.8.3, I perform a statistical test to show that my model predicts benchmark period prices accurately, which confirms that I have properly accounted for the changes that occurred in the industry, and that my model is reliable.

3.8. My overcharges measure the impact of Defendants' conspiracy on prices

(103)   Dr. Ugone claims that I am unable to establish the cause of the differences between my actual and but-for prices, and hence I am unable to show my damages were caused by Defendants' conspiracy.[158]   For all the reasons provided in my report and in my deposition testimony, Dr. Ugone is wrong.

(104)   To ensure that the overcharges that I measure are due to the Defendants' conspiracy and not due to some other factors, I constructed my econometric model in accordance with best practice to account for those other factors.[159]

(105)   My charge was to determine by how much Direct Action Plaintiffs were overcharged as a result of Defendants' conspiracy.   Consequently, I had to predict the effect of Defendants' conspiracy on prices.

(106)   A primary consideration in addressing my charge is that we can only observe prices—the outcome of interest—in the world with Defendants' conspiracy and not in the hypothetical world without it.   As a result, I must estimate the prices in a world that does not exist, a "counterfactual" world in which Defendants did not conspire.

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[157]   Dr. Ugone referenced an ABA book for his test.   Ugone report at ¶ 119.   However, the test was applied in a different context from the one here.   The book discusses the econometric model for *In re Silicon Antitrust Litigation* matter, but does not provide details, such as whether the silicon industry had experienced structural changes during the benchmark period.   Furthermore, if there were changes in the industry, it is unclear whether the model used in that matter allowed for changes in the relationship between the silicon prices and demand and supply factors during the benchmark period.   Therefore, Dr. Ugone has no basis to reference the ABA book to support his test.

[158]   *See* Section XII.D. in Ugone report.

[159]   It is well understood that the causal impact of any intervention (such as a conspiracy to fix prices) is measured by the difference between the outcome under the intervention and the outcome that would be expected to occur but for the intervention.   In this application (i.e., a price-fixing conspiracy), the outcomes under the intervention are the actual prices that prevailed when the conspiracy was in effect, and the outcomes that would be expected to occur but for the intervention are the but-for prices generated by using the estimated relationship between prices and demand and supply factors in the absence of a conspiracy.   The difference between the two prices is the measure of the impact of the conspiracy.

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(107)   Therefore, the estimation of the effects of Defendants' conspiracy is ultimately a predictive exercise. In order to accurately predict but-for prices, I turned to the econometric tools outlined in the large volume of peer-reviewed literature on the prediction of counterfactual effects. In my initial report I highlighted specific literature on treatment effects and event studies.[160] I also highlighted general scientific and economic studies that explicitly predict counterfactual outcomes.[161] My econometric model draws upon these well-accepted, peer-reviewed methods.

(108)   Despite the fact that my analysis is squarely within the mainstream of econometric best practices for predicting counterfactual outcomes, Dr. Ugone claims it is not.[162] Notably, Dr. Ugone makes his claim without reference, response, or rebuttal to any of the published, peer-reviewed literature my report cited regarding these best practices.[163] Rather, Dr. Ugone's technical critique is largely predicated upon a five page "Econometric Primer" whose stated purpose is to explain econometric basics "from a practical and nontechnical point of view."[164]

(109)   Moreover, because my prediction of the effect of the conspiracy is based on a regression, a probability-based framework, my prediction has an error rate that can be quantified. This answers Dr. Ugone's incorrect claim that my predicted overcharges might be due to chance.[165] I explain how Dr. Ugone's analysis is erroneous in Section 3.8.1. I then demonstrate how my predicted overcharges are quite improbable if Defendants' claims there was no effective conspiracy are true in Section 3.8.2. In Section 3.8.3, I also show that my predictions are accurate.[166]

3.8.1. Dr. Ugone incorrectly calculated the confidence intervals he reported

(110)   Dr. Ugone claims that my "PMDI and CFS polyols models lack sufficient precision to establish the existence of claimed damages to the Direct Action Plaintiffs."[167]

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[160]   *See* Raiff report, n. 323, 324.

[161]   *See* Raiff report, n. 322, 325.

[162]   Ugone report at ¶ 156.

[163]   That is, Dr. Ugone's report provides no response to the more than 20 papers I cited in support of my counterfactual methodology in footnotes 322 to 325 of my May 13, 2011 report.

[164]   *See* Epstein, R., "An Econometric Primer for Lawyers," *Antitrust*, Volume 25, No.3, Summer 2011, at p. 29.

[165]   Ugone report at ¶ 140. Specifically, Dr. Ugone asserts that the predictions of my PMDI and CFS Polyols models are not statistically different from zero.

[166]   Elsewhere in this report I have addressed Dr. Ugone's mistaken arguments regarding the coherence of my predicted overcharges, estimated coefficients, and econometric technique. See Sections 3.8, 3.6, and 3.4, respectively.

[167]   Ugone report at ¶ 4(f).

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(111)   This claim is based on confidence intervals that his staff asked a computer program called Stata to calculate. However, his staff made an obvious and severe error in their programming.

(112)   To calculate confidence intervals, Dr. Ugone's staff used a command called `predictnl` and two options called `ci` and `force`. The option `ci` is used to calculate confidence intervals. The option `force` is described as follows in the Stata help file:

> `force` calculate standard errors, etc., even **when possibly inappropriate**
>
> `force` forces the calculation of standard errors and other inference-related quantities in situations where `predictnl` would otherwise refuse to do so. The calculation of standard errors takes place by evaluating the numerical derivative of pnl_exp with respect to the coefficient vector e(b). If `predictnl` detects that pnl_exp is possibly a function of random quantities other than e(b), it will refuse to calculate standard errors or any other quantity derived from them. The `force` option forces the calculation to take place anyway. If you use the `force` option, there is no guarantee that any inference quantities (e.g., as standard errors) will be correct or that the values obtained can be interpreted. (Emphasis added)

(113)   Dr. Ugone's staff, in other words, forced Stata to perform a calculation that Stata cannot guarantee is correct. I have verified that to calculate Dr. Ugone's confidence intervals, the Stata command requires the `force` option to execute.[168] Dr. Ugone's staff made additional technical errors in their computation of the confidence intervals. In particular, they did not handle the variables accounting for the industry changes in 2005 correctly. As result of these technical errors, Dr. Ugone's confidence interval calculations are wrong.

3.8.2. Confidence intervals and hypothesis testing

(114)   In my June 27 deposition, following the submission of my Reply Report on May 25, counsel for Dow asked me a number of questions regarding the way in which I implemented the bootstrapping methodology[169] that I referenced in sections 3.8.2 and 3.8.3 of my Reply Report.

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[168]   In his deposition, Dr. Ugone conjectured that the force option might not be required to execute the Stata command, but he did not know one way or the other. Ugone deposition at 672-75.

[169]   To calculate the p-values for my econometric models, I used a "bootstrapping" methodology implemented in computer code run by a program called MATLAB. The bootstrap is a technique that mimics the process of sampling repeatedly from the population, by instead re-sampling repeatedly from the sample data. In this case, I used bootstrapping techniques to replicate 500 hypothetical "actual" price lines for the benchmark products over the entire time period, 1992 through 2008. By construction, these hypothetical replicated price lines have zero overcharges. I then run my econometric model against each of these hypothetical alternative price lines to

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In particular, counsel showed me a portion of the computer code used to generate but-for prices for each of the 500 hypothetical replicated price lines for the bootstrapping of my PMDI model[170] and asked whether I could confirm that the excerpt of code contained an error. From the limited information that counsel provided me during the deposition, I could not confidently answer his questions, but I have since confirmed that the bootstrapping code contained an error in predicting but-for prices for the 500 hypothetical replicated price lines in the bootstrapping of all three of my benchmark models.[171] In addition, in re-examining the bootstrapping code, I discovered an error that counsel for Dow did not raise.[172] I have corrected these errors in my backup materials and revised Figure 10 in this Revised Reply Report accordingly.

(115)   Correcting these coding errors does not lead me to change my opinions in this case. In particular, I remain of the opinion that the alleged conspiracy caused economic harm to plaintiffs and that I have derived the best, most reliable estimates of the overcharges possible. As discussed in my initial report and elsewhere in this Revised Reply Report, I carefully designed my econometric models to include the important supply and demand variables that influenced prices in the benchmark period. The results of my models are consistent with each other, even though they each use a different combination of supply and demand variables with respect to the different benchmark products. My models show that actual prices of the benchmark products were persistently higher and that the estimated overcharges for the benchmark products are all similar in their overall magnitude and patterns over time. I am aware of evidence that the defendants, in fact, expressly colluded on prices for TDI, MDI, and polyether polyols. I am also aware that Dr. McClave independently engaged in an econometric analysis for the class plaintiffs and arrived at overcharge estimates similar to mine.

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determine the "but for" prices in each of these hypothetical scenarios. I then estimate hypothetical overcharges for each of the 500 replicated price lines by subtracting the hypothetical but-for prices from the hypothetical actual prices. While these hypothetical price lines have no overcharges by construction, the hypothetical damage estimation may find negative (or positive) overcharges more than half the time. This is not a concern for the same reason that calibrating a scale precisely is not necessary to compare the weight of two people. The object of this test is simply to determine whether two things weighed on the same scale have different weights (statistically). That is, to the extent the 500 estimated overcharges tend to be underestimates of the overcharge, this would be true of my estimated overcharges (under the assumption there are no overcharges) as well.

[170] Counsel focused on the line of code that stated: "data.data.input=[datenum 3 (data.textdata(2:end,1))-datenum('30-Dec-1899') ny 4 data.data(:,2:end)]" and whether that code replaced the prices interacted with the post 2005 indicator variable in my model.

[171] Specifically, I should have used predicted lagged prices to estimate coefficients across the entire time period and for those aspects of my model that interact with the post-2005 indicator variable. I used predicted lagged prices for the entire time period, but inadvertently used *actual* prices in combination with the post-2005 indicator variable.

[172] For my results for the hypothesis test corresponding to class period overcharges, which appear in my backup materials, my calculations used actual December 1998 prices to calculate class-period but-for prices in January 1999. The calculations should have used but-for prices from December 1998. Because my model is a dynamic forecast, this mistake caused the subsequent class period but-for prices to be inaccurate as well. Corrected results for the class period are similar to those reported for the conspiracy period in Figure 10 and are in my backup materials.

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(116)   While I stand by my opinion that no further confirmation analysis was needed because my models were designed in accordance with best practices and predict actual prices in the benchmark period well, in response to Dr. Ugone's inappropriate use of confidence intervals in his Rebuttal Report, I used a technique used by econometricians called "hypothesis testing" to evaluate through statistical analysis whether the estimated overcharges for each benchmark product were statistically different from zero. In hypothesis tests, econometricians set up a "null hypothesis," which is often a straw man, to see if they can knock it down on the basis of statistical evidence alone.[173]

(117)   Hypothesis testing is often explained through a coin-flipping example. Assume that I flipped a coin 50 times and it resulted in 18 heads and 32 tails and I wanted to test if that was the result of pure chance or if the coin was biased. Using a hypothesis test, I would set up my null hypothesis: "The coin is fair (not biased)," meaning the results of the 50 flips (18 heads/32 tails) were due to chance alone.[174] Through a mathematical formula, I would then calculate the probability that I would get at least 32 heads or 32 tails in 50 coin flips with a fair (non-biased) coin. This probability is expressed as a "p-value." In my coin-flipping example, the p-value would be 6.5%, meaning that if you repeated the 50 coin flips with a fair (non-biased) coin, you would flip fewer than 32 heads and 32 tails 93.5% of the time, but 6.5% of the time you would arrive at results that are at least as extreme, *i.e.*, at least 32 heads or tails. Stated differently, with a fair coin, you would get a false positive 6.5% of the time by using 32 or more heads or tails as the cutoff for determining whether a coin was unfair after 50 flips.[175]

(118)   To be clear, the p-value does ***not*** represent the probability that the null hypothesis is true (that the coin is fair),[176] nor can it be considered as evidence that the test results were a fluke.[177]

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[173]   Hypothesis tests are widely used through scientific fields. For perspectives on how they are used (and misunderstood) throughout psychology, medicine, and ecology, see Jacob Cohen, "The Earth Is Round ($p < .05$)," *American Psychologist* 49 (1999): 997–1003; Raymond Nickerson, "Null Hypothesis Significance Testing: A Review of an Old and Continuing Controversy," *Psychological Methods* 5 (2000): 241–301; Steven Goodman, "A Dirty Dozen: Twelve P-Value Misconceptions," *Seminars in Hematology* 45 (2008): 135–40; and Douglas Johnson, "The Insignificance of Statistical Significance Testing," *Journal of Wildlife Management* 63 (1999): 763–72.

[174]   "Herein lies the core reasoning of statistical tests: *a sample outcome that would be extreme if a hypothesis* [H_0] *were true is evidence that the hypothesis* [H_0] *may not be true*." David Moore, George McCabe, Layth Alwan, Bruce Craig, and William Duckworth, *The Practice of Statistics for Business and Economics*, 3rd. ed. (New York: W.H. Freeman and Company, 2011), at 353 (emphasis in original).

[175]   Such a false positive is called "Type I error." One can of course reduce the probability of wrongly rejecting the hypothesis of fairness by using a stronger threshold (*i.e.,* requiring a lower p-value to reject the null hypothesis), but then one will commit more of the related error: failing to reject the hypothesis that a coin is fair when in fact the coin is biased. Such a false negative is called "Type II error." *See* David Moore, George McCabe, Layth Alwan, Bruce Craig, and William Duckworth, *The Practice of Statistics for Business and Economics*, 3rd. ed. (New York: W.H. Freeman and Company, 2011), at 382–83. These concepts have familiar analogs in law: convicting an innocent person is Type I error, while acquitting a guilty person is a form of Type II error.

[176]   "Of all the false beliefs about NHST [null hypothesis significance testing], this one [the belief that *p* is the

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Moreover, hypothesis testing may help an economist evaluate **whether** there is a statistical difference from zero, but it does not help an economist understand the **magnitude** of the difference. A hypothesis test may show that a difference exists, but that difference could be infinitesimal and of no practical significance. Conversely, a hypothesis test may not show whether a difference exists, even when a substantial difference does in fact exist. In general, hypothesis testing is considered of limited value, which is why I did not use it in my initial report.[178]

(119)   Historically, users of statistics compared the p-value against an arbitrary threshold, such as 5% or 10%, and labeled any p-value under that threshold as indicating a "statistically significant" result and any p-value above it as indicating a "statistically insignificant" result – as if there is a meaningful difference between a p-value of 9% and a p-value of 11%. The modern literature supports the view that p-values should instead be viewed along a spectrum of so-called significance.[179,180]

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probability that then null hypothesis is true and that $1-p$ is the probability that the alternative hypothesis is true] is arguably the most pervasive…the value of p obtained from a null hypothesis statistical test is not the probability that H_0 is true…Furthermore, inasmuch as p does not present the probability that the null hypothesis is true, its complement is not the probability that the alternative hypothesis, H_A, is true." Raymond Nickerson, "Null Hypothesis Significance Testing: A Review of an Old and Continuing Controversy," *Psychological Methods* 5 (2000): 241–301, at 246; Steven Goodman, "A Dirty Dozen: Twelve P-Value Misconceptions," *Seminars in Hematology* 45 (2008): 135–40, at 136 ("Below are listed the most common misperceptions of the P value…***Misconception #1:*** *If P = .05, the null hypothesis only has a 5% chance of being true*. This is, without a doubt, the most pervasive and pernicious of the many misconceptions about the *P* value. It perpetuates the false idea that the data alone can tell us how likely we are to be right or wrong in our conclusions. The simplest way to see that this is false is to note that the *P* value is calculated under the assumption that the null hypothesis is true. It therefore cannot simultaneously be a probability that the null hypothesis is false. Let us suppose we flip a penny four times and observe four heads, two-sided *P* = .125. This does not mean the probability of the coin being fair is only 12.5%"); Jacob Cohen, "The Earth Is Round ($p < .05$)," *American Psychologist* 49 (1999): 997–1003, at 997-98; Douglas Johnson, "The Insignificance of Statistical Significance Testing," *Journal of Wildlife Management* 63 (1999): 763–72, at 765. If I also knew the coin was drawn from a mix of 100 fair coins and one unfair coin, the coin would likely be fair. If I instead knew the coin was drawn from a mix of 100 biased coins and one fair coin, the coin would likely be biased. Because we do not know the mix from which the coin was drawn, the p-value allows us to say the most that can be said absent more information: the probability of getting as many heads or tails as I did, if the coin happens to be fair, is 6.5%.

[177]   ***Misconception #2:*** *A nonsignificant difference (e.g., P > .05) means there is no difference between groups*. A nonsignificant difference merely means that a null effect is statistically consistent with the observed results, together with the range of effects included in the confidence interval. It does not make the null effect the most likely. The effect best supported by the data from a given experiment is always the observed effect, regardless of its significance." Steven Goodman, "A Dirty Dozen: Twelve P-Value Misconceptions," *Seminars in Hematology* 45 (2008): 135–40, at 136.

[178]   The literature emphasizes the need to assess practical significance. "Remember the wise saying: *statistical significance is not the same as practical significance*." David Moore, George McCabe, Layth Alwan, Bruce Craig, and William Duckworth, *The Practice of Statistics for Business and Economics*, 3rd. ed. (New York: W.H. Freeman and Company, 2011), at 372 (emphasis in original).

[179]   "Accept-reject rules like this [5% significance level] are generally unnecessary for reasonable scientific inquiry. Simply reporting p-values and allowing readers to decide on significance seems a better approach." Sanford Weisberg, *Applied Linear Regression*, 3rd ed. (Hoboken: John Wiley & Sons, 2005), at 31.

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(120)   The results of the hypothesis tests of my econometric models are set forth in Figure 10 below. The "probability of false positive if no overcharge exists" column contains the p-values for each model, i.e., the probability that my models would estimate overcharges as large as they did if, in fact, true overcharges for each product are actually zero. As can be seen, for the three benchmark products, the probabilities of such a "false positive" are low: TDI 80/20 — 0.4%; CFS polyols — 7.2%; PMDI — 19.2%. These low probabilities are evidence that there was an effective conspiracy that caused plaintiffs economic harm in the amounts estimated by my models.

"Users of statistics have often emphasized standard levels of significance such as 10%, 5%, and 1%. This emphasis reflects the time when tables of critical values rather than computer software dominated statistical practice. The 5% level ($\alpha = 5\%$) is particularly common. **There is no sharp border between 'significant' and 'insignificant,' only increasingly strong evidence as the P-value decreases.**" David Moore, George McCabe, Layth Alwan, Bruce Craig, and William Duckworth, *The Practice of Statistics for Business and Economics*, 3rd. ed. (New York: W.H. Freeman and Company, 2011), at 371 (emphasis in original).

[180]   The literature also emphasizes the need to consider a statistical result in light of the totality of the evidence. For example:

"[T]here is no number generated by standard methods that tells us the probability that a given conclusion is right or wrong. The determinants of the truth of a knowledge claim lie in combination of evidence both within and outside a given experiment, including the plausibility and evidential support of the proposed underlying mechanism." Steven Goodman, "A Dirty Dozen: Twelve P-Value Misconceptions," *Seminars in Hematology* 45 (2008): 135–40, at 139.

"Psychological knowledge is acquired, as is knowledge in other fields, as a consequence of the cumulative effect of many experiments and nonexperimental observations as well. It is the preponderance of evidence…that determines the degree of credibility that is given to hypotheses, models, and theories." Raymond Nickerson, "Null Hypothesis Significance Testing: A Review of an Old and Continuing Controversy," *Psychological Methods* 5 (2000): 241–301, at 291.

"Rejection of a statistical hypothesis would constitute a piece of evidence to be considered in deciding whether or not to reject a scientific hypothesis." Douglas Johnson, "The Insignificance of Statistical Significance Testing," *Journal of Wildlife Management* 63 (1999): 763–72, at 768.

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Figure 10 Probability of false positive of estimated conspiracy period overcharges

Benchmark product category	Conspiracy period percentage overcharges	Probability of false positive if no overcharge exists
PMDI	14.3%	0.192
TDI 80/20	11.4%	0.004
CFS polyols	12.2%	0.072

3.8.3. Dr. Ugone wrongly claims that my model yields overcharges that are contrary to Direct Action Plaintiffs' allegations

(121)   Dr. Ugone claims that my model is unreliable because it predicts overcharges during the conspiracy that are smaller than some prediction errors seen outside the conspiracy. He interprets this as a "nonsensical result" that indicates my conclusions are unreliable.[181]

(122)   To illustrate why Dr. Ugone's claim is wrong, consider a situation in which the conspiracy is not effective over a certain period of time. In such a case, the overcharges for that period should be zero. However, according to Dr. Ugone's logic, if a model would, correctly, estimate zero overcharges for that period, then that model should not have any prediction errors. This is nonsensical because every econometric model will, by its very nature, have prediction errors.

(123)   The relevant question is whether the average prediction errors over the benchmark period (the nonconspiratorial period) are zero from practical and statistical points of view. In analyzing the issues raised by counsel regarding the computer code, I confirmed that the same coding errors applied to my calculation of the p-values for Figure 11. I have corrected those errors, as set forth in Figure 11 below.

(124)   These changes do not cause me to change my opinions. The dynamic forecasts of my three econometric models have prediction errors that are near zero in size during the benchmark period (per the second column). The close fit of forecasted and actual prices on average during the benchmark period confirms what I see when I look at the forecasts, which is that forecasted prices closely track actual prices during the benchmark period. This tells me my models properly account for all important supply and demand variables. The small average prediction error values in Figure 11 serve to highlight the difference between practical versus statistical significance—

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[181]   Ugone report at ¶ 4(g).

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here, all three average prediction errors are so low that they have no practical significance, regardless of their statistical significance or insignificance.[182]

Figure 11 Average prediction errors over the benchmark period

Benchmark product category	Average prediction error	Statistical significance
PMDI	-0.7%	0.501
TDI 80/20	-0.3%	0.082
CFS polyols	0.6%	0.206

(125)   In addition, Dr. Ugone claims that my model is unreliable because it produces negative overcharges over certain time periods.[183] Inspecting my results indicates the following:

■   TDI overcharges were negative at the start of the conspiracy (1994), at the end of the conspiracy (2003), and in late 2001/early 2002;

■   MDI overcharges were negative at the start of the conspiracy (1994) and at the end of the conspiracy (2003);

■   Polyols overcharges were negative at the start of the conspiracy (1995), at the end of the conspiracy (2003), and in late 2001/early 2002.

(126)   These patterns in my estimated overcharges are consistent with a conspiracy whose effectiveness was lower at the start and at the end of the conspiracy period than in the intervening years, and with a conspiracy whose effectiveness was lower in late 2001/early 2002.

(127)   Furthermore, as I show in Figure 10, my overcharges are positive. Therefore, Dr. Ugone is plainly incorrect when he claims that my model produces "predicted negative overcharges" that are "large, systematic, and persistent."[184]

3.9. My overcharges are plausible and sustainable

(128)   Dr. Ugone claims that I did not establish that the but-for prices predicted by my models were "sustainable" given the implied changes in product-level profitability.[185] Dr. Ugone claims that

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[182]   PMDI has the least statistically significant value but the largest in absolute magnitude, while TDI 80/20 has the most statistically significant value but the smallest in absolute magnitude.

[183]   Ugone report at ¶ 147.

[184]   Ugone report at ¶ 147.

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over a period of years, "competitive market forces and pressures will tend to exist for prices to increase to the point where companies are at least breaking even on those products from an economic perspective."[186] He claims that my predicted but-for prices would have resulted in "losses" that would have caused Defendants to react by "possibly" decreasing production or closing down plants. In other words, Defendants may not have been willing "in the long run" to supply urethane chemicals at my predicted but-for prices.[187] Dr. Ugone's assertion allows for two possibilities. To the extent that Defendants would not have decreased supply, Dr. Ugone's opinion is irrelevant. The discussion in this section, therefore, pertains to the other possibility, that supply would have decreased.

(129)   I address below the numerous problems with his opinions.

3.9.1. Dr. Ugone's opinion is predicated on the wrong measure of profitability

(130)   As Dr. Ugone admits, companies will find it profitable to continue operating in the "short run" if their sales revenues cover their variable costs,[188] though he refused to take a position on what he meant by "long run" and "short run."[189] As a matter of economic theory, if a company's sales revenues exceed its variable costs, its revenues contribute to covering the firm's fixed costs. A decision to shut down production when revenues exceed variable costs makes a company worse off, at least in the short run.

(131)   In performing his analysis of whether Defendants would decrease production or shut down plants, Dr. Ugone uses an inappropriate measure of profitability that includes fixed costs. Specifically, he uses EBIT, an accounting term meaning Earnings Before Interest and Taxes, that takes into account variable costs and a company's allocated fixed costs. For Dow, Dr. Ugone's EBIT calculations include "Non-Manufacturing Expense," "Research & Development," and "Corporate Governance," among others. For BASF, Dr. Ugone's EBIT calculations include "Fixed Manufacturing Costs" and "Administration," among others. Dow testified that fixed costs reflected in EBIT can include costs that are arbitrarily allocated to a particular product or

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[185] Ugone report at ¶ 86.

[186] Ugone report at ¶ 88 (emphasis in original).

[187] *See, e.g.,* Ugone deposition at 781:2-782:8.

[188] Ugone deposition at 271:20-23.

[189] Ugone deposition at 271:12-273:16. Dr. Ugone did admit that in his view the "long run" lasted "over a period of years." *Id*. at 756:12-757:4, 789:19-22.

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business, such security at a plant that produces multiple products.[190] These fixed costs do not affect the company's short-run decision making.

(132)   By using EBIT to evaluate whether Defendants would shut down, Dr. Ugone effectively performed a "long run" analysis. Given the time, financial investment, and strategic consideration required by Defendants to build capacity and manufacture TDI, MDI, or polyols, it is implausible to think that Defendants' long run planning horizon would be as short as the periods specified by Dr. Ugone. In fact, as discussed below, the Defendants' decisions and actions during this time period make it obvious that Dr. Ugone's long run analysis is inappropriate and inconsistent with how they actually make their production decisions. His analysis is therefore unhelpful and unreliable for the task at hand.

3.9.2. A more appropriate measure shows that Dr. Ugone's opinion is wrong

(133)   As opposed to Dr. Ugone's approach, economic theory suggests that contribution margin is a more appropriate way to evaluate a company's decision to shut down (or its willingness to supply). A company's contribution margin (or variable cost margin) is the amount by which revenues exceed variable costs.[191] As I noted above, if a company has a positive contribution margin, making and selling that product will generate revenues that contribute to covering the company's fixed costs. This is particularly important in the urethanes industry, which is characterized by relatively high fixed costs.[192]

(134)   Dr. Ugone's own exhibits calculate BASF's contribution margin for TDI, MDI, and polyols, though he does not mention contribution margin in his report. Analyzing the contribution margin shows that BASF would have had a *positive* contribution margin with my but-for prices in *every* year from 1996 to 2003 for all three benchmark category products.[193] In other words, at the but-for prices implied by my economic model, BASF's sales of all three polyether polyol products would have helped to cover BASF's fixed costs and, therefore, BASF would have continued to produce. As summarized in Figure 12, the lowest contribution margin BASF would have had from 1996 to 2003 at my but-for prices was $24.9 million, according to Dr. Ugone's own

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[190] *See, e.g.,* 30(b)(6) Deposition of Thomas Feige, Jr., Dow, (December 1, 2010) at 73:12–78:17.

[191] *See, e.g.,* Stickney, Clyde P. and Weil, Roman L, *Financial Accounting: An Introduction to Concepts, Methods and Uses* 10th edition (2003), at 882.

[192] As noted in my revised report at ¶ 118: "It was expensive and time-consuming to build a plant to manufacture TDI, MDI, or polyols. It took approximately 2-3 years to permit and build a TDI or MDI plant, and a year or more for a polyols plant. The cost of building a TDI and MDI plant was in the hundreds of millions of dollars."

[193] Ugone report at Exhibits 42, 46, 50.

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calculations. In several years, BASF's product-specific contribution margin would have been close to $100 million.[194]

Figure 12 BASF contribution margins after applying my but-for prices, per Dr. Ugone ($ millions)[195]

Year	TDI	MDI	Polyols
1996	$ 97.4	$ 57.3	$ 50.5
1997	$ 68.3	$ 62.5	$ 46.6
1998	$ 55.6	$ 63.7	$ 32.2
1999	$ 69.2	$ 40.7	$ 24.9
2000	$ 76.0	$ 48.7	$ 35.5
2001	$ 42.5	$ 78.9	$ 65.0
2002	$ 41.3	$ 92.9	$ 45.3
2003	$ 33.1	$ 99.2	$ 50.8

(135)   Taking TDI in 2001 as an example, Dr. Ugone calculates that BASF would have recorded a but-for contribution margin of positive $42.5 million. At this contribution margin level, BASF would have been more than "willing to supply" TDI to the market. In fact, if BASF decided to shut down in 2001, its overall profitability would have been $42.5 million *lower* because its contribution margin would have been zero for TDI. Specifically, its EBIT for TDI would have dropped from negative $31.9 million to negative $74.4 million, or an additional loss of $42.5 million.

(136)   Dow's product-line financial statements for TDI, MDI, and polyols do not report contribution margin. Dow does report a "trade standard cost" that appears to be reasonably close to variable cost, though it also appears to include some fixed costs and may exclude some variable costs. Using Dow's trade standard cost, there is only one year for one product (TDI in 1998) where the but-for trade standard margin is negative from 1996 to 2003. In all other product-years from 1996 to 2003, Dow's margin based on its "trade standard cost" is positive using my but-for prices.[196] This is summarized in Figure 13.

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[194]   Ugone report at Exhibit 42.

[195]   Ugone report at Exhibits 42, 46, and 50.

[196]   Worth noting is that in 2004 and 2005 (i.e., post-conspiracy), Dow's trade standard margin on TDI was negative as well, yet Dow continued to operate.

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Figure 13 Dow's "trade standard margin" after applying my but-for prices, per Dr. Ugone ($ millions)[197]

Year	TDI	MDI	Polyols
1996	$ 14.2	$ 72.3	$ 159.2
1997	$ 7.9	$ 93.5	$ 131.8
1998	$ (0.9)	$ 35.0	$ 40.0
1999	$ 3.0	$ 14.7	$ 10.8
2000	$ 5.6	$ 2.0	$ 33.7
2001	$ 7.5	$ 13.5	$ 69.7
2002	$ 5.2	$ 28.5	$ 54.6
2003	$ 5.1	$ 36.9	$ 66.6

(137)   In short, using a more appropriate measure (i.e., contribution margin or a surrogate, and not EBIT) to evaluate whether BASF and Dow would have shut down or reduced supply of MDI, TDI, and polyols strongly suggests that they would not have done so. This directly contradicts Dr. Ugone's assertions.

3.9.3. Dr. Ugone's assertions are contradicted by his own analysis and are inconsistent with industry facts

(138)   In evaluating the implications of my but-for prices, Dr. Ugone reaches conclusions that do not make economic sense and are contradicted by his own analysis. Dr. Ugone asserts that:

> As a matter of economics, if companies selling products such as those at-issue in this case are unable to earn revenue sufficient to cover the total costs associated with the product line over a period of years, competitive market forces and pressures will arise for prices to increase to the point where companies are at least breaking even from an economic perspective. For example, it does not make economic sense to conclude that Dow should have accumulated $263 million in losses in its TDI business over the 1998 to 2003 time period instead of the $216 million in losses actually experienced."[198]

(139)   Dr. Ugone's assertions are contradictory and do not make economic sense, even when analyzing EBIT margins as Dr. Ugone suggests. Using Dr. Ugone's preferred EBIT measure, Dow's financials show that despite losing money for TDI on an EBIT basis for *nine* consecutive years

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[197]   Ugone report at Exhibits 41, 45, and 49.

[198]   Ugone report at ¶ 95.

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from 1998 to 2006, Dow continued to produce TDI and, in fact, increased its production from 80 million pounds to almost 100 million pounds in 2005.[199] This is summarized in Figure 14. On its own, this shows that Dr. Ugone's error on relying on EBIT to analyze supply decisions during the conspiracy.

Figure 14 Dow EBIT margins and actual production volume, per Dr. Ugone[200]

Year	TDI		MDI		Polyols	
	Net Trade Units (millions lbs)	EBIT (millions)	Net Trade Units (millions lbs)	EBIT (millions)	Net Trade Units (millions lbs)	EBIT (millions)
1996	97.2	$ 16.4	256.4	$ 75.6	634.8	$ 129.8
1997	85.2	$ 4.2	268.9	$ 67.6	611.4	$ 102.2
1998	80.0	$ (4.0)	223.5	$ 39.4	509.8	$ 63.2
1999	75.4	$ (28.2)	181.5	$ 29.6	484.7	$ 34.0
2000	88.6	$ (29.2)	185.1	$ 13.6	504.2	$ 37.5
2001	88.3	$ (68.5)	149.5	$ 13.4	380.1	$ 15.6
2002	99.7	$ (49.0)	136.8	$ (0.7)	351.0	$ 13.1
2003	95.5	$ (36.7)	150.9	$ 2.7	353.1	$ 3.8
2004	84.6	$ (45.9)	161.9	$ (41.4)	396.6	$ 3.2
2005	99.7	$ (53.1)	148.8	$ (47.9)	383.2	$ 72.1
2006	90.3	$ (34.1)	133.1	$ (56.7)	333.7	$ 83.3
2007	80.6	$ 22.8	113.2	$ (1.4)	313.7	$ 58.9

(140) Dr. Ugone, however, ignores Dow's expansion of its TDI business despite its annual losses. Instead, he claims that the increase from a cumulative EBIT loss of $216 million to a cumulative loss of $263 million would "not make economic sense." What does not make economic sense is to conclude that Dow would have exited the industry or reduced production had its losses on TDI sales increased from an already noticeable loss to a somewhat larger one. Dr. Ugone provides no economic rationale or authority to support his opinion. Dr. Ugone refused to say whether it would have made economic sense for Dow to stay in business if it had earned just $1 million less per year during the conspiracy period, or where between a $216 million loss and a $263 million loss from 1998 to 2003 would Dow have exited the industry.[201] In fact, Dr. Ugone's own analysis

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[199] Ugone report at Exhibit 39.
[200] Ugone report at Exhibits 39, 43, 47.
[201] Ugone deposition at 778:1-782:8.

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indicates that Dow sustained losses of $46 million and $53 million in 2004 and 2005 for TDI, respectively, yet Dow chose not to exit the industry.[202]

(141)   A similar analysis holds for MDI. Dr. Ugone ignores the fact that Dow lost more than $146 million combined from 2004 to 2007 (all after the conspiracy) in its MDI business, yet continued to stay in business and sell MDI.[203]

(142)   While Dow was profitable in its polyols business, Dr. Ugone has provided no basis to conclude that it would have been unwilling to sustain year-over-year losses in polyols as it did in TDI and MDI.

(143)   To summarize, Dr. Ugone's proposed methodology for evaluating Dow's conduct is wrong. Even if it were right, the evidence directly contradicts his assertion. As a result, I find his assertion that my but-for price levels could have caused Dow to restrict output to be misleading, unhelpful, and unreliable.

3.9.4. Dr. Ugone's profitability analysis ignores the overlap between polyether polyol products and other products

(144)   Dr. Ugone also mistakenly focuses on product-level accounting profits without considering Defendants' actual business incentives and the role that polyether polyol products play in the integrated production processes of BASF and Dow. For example, as Dr. Elzinga acknowledged, the "general driver" of Dow's strategy in the urethanes market was to maximize the return on its propylene oxide ("PO") business and that "[t]o understand Dow's business model in urethanes, the company's PO business must be understood."[204] In fact, one of Dow's employees told Dr. Elzinga that "Dow's strategy towards polyurethanes is the desire to maximize the return back to Dow's investment in its capacity to produce Propylene Oxide," not necessarily to maximize polyether polyol products profitability.[205] Yet, Dr. Ugone never considered Dow's profitability in the PO business or its stated commitment to being the leading PO producer in the world. At deposition, in fact, Dr. Ugone could not even say whether Dow made PO.[206] Similarly, Dr.

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[202]   Note that BASF also lost money in its TDI business during this time. *See* Ugone Exhibit 42.

[203]   Specifically, on an EBIT basis Dow lost $41 million in 2004, $48 million in 2005, $57 million in 2006, and $1 million in 2007 in its MDI business. Ugone report at Exhibit 43.

[204]   Elzinga report at 47. PO is the primary input into polyether polyols. Polyether polyols provide approximately 60-70% of the demand for PO, followed by propylene glygol ("PG") at approximately 20%. TDCC_PU239658 at TDCC_PU239663.

[205]   Steven English interview notes at 2.

[206]   Ugone deposition at 772:13-16; Dow, "About Propylene Oxide," http://www.dow.com/propyleneoxide/about/index.htm.

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Ugone did not consider BASF's "verbund" philosophy and how that affected its view of its polyether polyol products investments.[207]

(145)   If Dow reduced its polyols production, it would either have to find a corresponding outlet for the PO it produced or scale back its PO production. Although Dow was a dominant PO producer in the 1990s and a key source of supply for Bayer, in 1999/2000 Bayer canceled its contract with Dow and found another source of PO.[208] To deal with that change, Dow increased its polyols production capacity.[209] In addition, because TDI and MDI were viewed as complements to polyols, Dow could not unilaterally scale back production of TDI and MDI without also risking loss of polyol sales. Further, TDI and MDI production provided Dow with certain co-products that it could not sell or use internally if it restricted polyether polyol products output.[210] One can simply not look at the financial results for polyether polyol products in isolation, as Dr. Ugone attempts to do.

3.9.5. Contrary to Dr. Ugone's claim, the pattern of my overcharges is reasonable

(146)   Dr. Ugone also claims that my estimated overcharges are "widely varying" over time, "do not move in a consistent pattern across all three product classes," and in some months "are high for some benchmark products and not others."[211] It is not clear why, as a matter of economics, Dr. Ugone expects the overcharges across the three products to be constant over time. Nor is it clear precisely what it would mean for the overcharges to "move consistently."

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[207] Quoting BASF:

What Is Verbund? BASF has long been recognized for making the most of its integrated approach to manufacturing, research and its overall management philosophy. This philosophy, together with the maximum integration of infrastructure, processes, energy and waste management, is known as Verbund, a German word meaning "linked" or "integrated" to the maximum degree.

In North America, BASF's businesses and milestones reflect the application of this philosophy. Verbund provides competitive advantages because it represents more than simple integration. It represents entire interlocking value chains, from chemical building blocks produced primarily for BASF use to cyclically resilient specialty and fine chemicals that offer higher returns.

BASF's investments and acquisitions highlight more than market opportunities; they also demonstrate the expansion of value chains, a key concept for understanding Verbund. Value chains, capital investments and management's approach to market opportunities together enhance BASF's overall returns, serve customers and consistently make high-quality products…better.

BASF Corporation, "What is Verbund?", http://www2.basf.us/about/verbund.html.

[208] Steven English interview notes at ¶ 4.

[209] Steven English interview notes at ¶ 4.

[210] Raiff report at ¶¶ 107, 111.

[211] Ugone report at ¶ 144.

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(147)   In response to Dr. Ugone's criticism, it is important to note that the overcharges over the entire conspiracy are on average rather similar across the products. The average overcharge on TDI products was 12.3%, the average overcharge on MDI products was 13.0%, and the average overcharge on polyols products was 10.0%.[212]

(148)   Conspiracies typically vary in their effectiveness over time. For example, the Defendants' guilty pleas in *DRAM* admitted that their illegal conduct included "agreements to limit the rate of price declines, which were achieved with varying levels of effectiveness."[213] Dr. Bernheim's *Vitamins* overcharges vary throughout time as well.[214] The academic literature on conspiracies has also shown cartel effectiveness varies over time.[215]

(149)   Moreover, the pattern of low overcharges that I initially observe is consistent with the fact that it takes some time for conspiracy members to establish an effective conspiracy. Instead of simply raising prices by some set amount, cartels tend to raise price gradually. The initial phase of the conspiracy in which price is elevated to its optimal and more stationary level is sometimes referred to in the economics literature as the "transition phase." Actual price paths of past conspiracies show that transition phase is a common feature of conspiracies.[216] One explanation

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[212]   These overcharges are similar to Dr. McClave's reported overcharges (14.0% for TDI, 16.0% for MDI, and 14.0% for polyols). McClave report at 59.

[213]   *See, e.g.,* Plea Agreement at ¶ 4, *United States v. Elpida Memory, Inc.,* No. CR 06-0059 (PJH) (Jan. 27, 2006). (Note that DRAM presents yet another example of a conspiracy in which prices did not steadily increase throughout the collusive period.).

[214]   *See, e.g.,* Bernheim *Vitamins* report at 261–93.

[215]   A school milk cartel in Ohio operated from 1980 through 1991. The effect of this cartel varied from -0.3% (in 1990–1991) to 11.3% (in 1981–1982) during the cartel period. *See* Robert H. Porter and J. Douglas Zona, "Ohio School Milk Markets: An Analysis of Bidding," *RAND Journal of Economics* 30 (1999): 263–88. Similarly, a school milk cartel in Kentucky during the 1980s had varying effects on prices. *See* Robert F. Lanzillotti, "The Great School Milk Conspiracies of the 1980s," *Review of Industrial Organization* 11 (1996): 413–58.

A bid-rigging cartel in the sale of frozen seafood to the Defense Personnel Support Center operated from 1981 through 1989. The authors estimate the conspiracy elevated prices by an average of 30.4% from July 1984 through November 1986. They then estimate a 23.1% overcharge from November 1986 through July 1988. Luke M. Froeb, Robert A. Koyak, and Gregory J. Werden, "What is the effect of bid-rigging on prices?" *Economics Letters* 42 (1993): 419–23.

The citric acid cartel from 1991–1996 had gradually increasing effects on price. John M. Connor, "What can we learn from the ADM Global Price Conspiracies?" (working paper, Purdue University, 1998). *See also* Joseph E. Harrington, "Behavioral Screening and the Detection of Cartels," in *European Competition Law Annual 2006: Enforcement of Prohibition of Cartels*, eds. Claus-Dieter Ehlermann and Isabela Atanasiu (Portland: Hart Publishing, 2007).

The lysine cartel operated from 1992–1995. The cartel started in August 1992 but was reported as ineffective during March–July 1993. It was effective again later in the cartel period. John M. Connor, "Global Cartels Redux: The Amino Acid Lysine Antitrust Litigation," in *The Antitrust Revolution*, 4th ed., eds. John E. Kwoka and Lawrence J. White (Oxford: Oxford University Press, 2004). *See also* Yuliya Bolotova, John M. Connor, and Douglas J. Miller, "The Impact of Collusion on Price Behavior: Empirical Results from Two Recent Cases," *International Journal of Industrial Organization* 26, no. 6 (2008): 1290–1307.

[216]   *See, e.g.,* Joseph E. Harrington, "Behavioral Screening and the Detection of Cartels," in *European Competition*

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for why an initial transition phases occurs is that conspiracy members attempt to "avoid creating suspicions that a cartel has formed."[217]

(150)   Additionally, the ability to effectively implement price increases varies over the life span of a cartel agreement due to market conditions. It would be rare indeed for a cartel to impose, say, a 15% overcharge that did not vary over time, and that the cartelists did not change in response to demand and cost conditions. As economics has long recognized, fluctuations in demand and cost conditions impact the effectiveness of cartel. Two competing theories have emerged in the economics literature. According to one accepted theory, cartel members sustain the collusive outcomes as long as the market price is "sufficiently" high and initiate a punishment phase once the market price is below a certain level due to price cuts or low demand.[218] Hence, the cartel is more effective when there is high demand. The alternative theory says that cartels are less effective during economic booms because there is more to gain from cheating.[219] On the other hand, during recessions, firms tend to collude more successfully and it is easier to sustain high collusive prices because there is less incentive to cheat. Both these theories imply that cartels may operate with varying levels of effectiveness over their lifetime.

(151)   For related reasons, overcharges typically vary across products in a conspiracy. One would not expect the overcharges across products to be identical over time unless Defendants, as part of their conspiracy, chose to have the overcharges be identical, regardless of underlying differences in cost and demand.

(152)   In addition, the overcharges that Dr. Ugone claims "vary widely" across products are broadly similar across the entirety of the conspiracy and show a positive relationship over time.[220] See Figure 15, Figure 16, and Figure 17 which plot average quarterly overcharges in one benchmark

Law Annual 2006: Enforcement of Prohibition of Cartels, eds. Claus-Dieter Ehlermann and Isabela Atanasiu (Portland: Hart Publishing, 2007).

[217]   Joseph E. Harrington and Joe Chen, "Cartel Pricing Dynamics with Cost Variability and Endogenous Buyer Detection," *International Journal of Industrial Organization* 24, no. 6 (2006): 1185–1212.

[218]   Edward J. Green and Robert H. Porter, "Noncooperative Collusion under Imperfect Price Information," *Econometrica* 52, no. 1 (1984): 87–100; Steven G. Lanning, "Costs of Maintaining a Cartel," *The Journal of Industrial Economics* 36, no. 2 (1987): 157–74; Glenn Ellison, "Theories of Cartel Stability and the Joint Executive Committee," *RAND Journal of Economics* 25, no. 1 (1994): 37–57.

[219]   Julio J. Rotemberg and Garth Saloner, "A Supergame Theoretical Model of Price Wars during Booms," *American Economic Review* 76, no. 3 (1986): 390–407; John Haltiwanger and Joseph E. Harrington, "The Impact of Cyclical Demand Movements on Collusive Behavior, " *RAND Journal of Economics* 22, no. 1 (1991): 89–106; Severin Borenstein and Andrea Shepard, "Dynamic Pricing in Retail Gasoline Markets," *RAND Journal of Economics* 27, no. 3 (1996): 429–51.

[220]   I do not believe that Dr. Ugone is correct in saying that the overcharges should not "widely vary." I show the overcharges to quantify the extent to which they vary in the first place. Dr. Ugone did not do this or anything beyond mere visual inspection of the data. Dr. Ugone's depiction of the overcharges makes it difficult to determine whether the overcharges tend to move together over time. By plotting the data in a scatter plot, one can direcly see that the overcharges do tend to move in the same direction over time (Ugone report at Exhibit 62).

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product category price against another. The black lines in the Figures below show that the overcharges over benchmark product category prices always demonstrate a positive relationship, and therefore, do not vary widely.

**Figure 15 PMDI v. TDI 80/20 average quarterly overcharges**
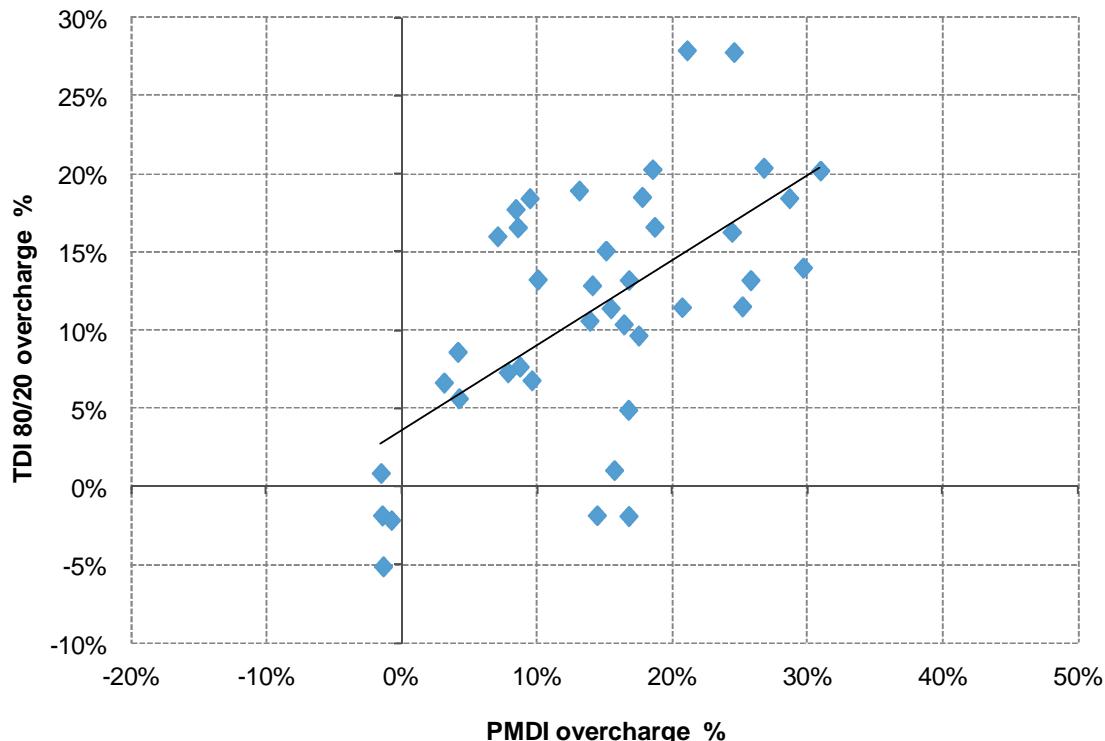
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Figure 16 TDI 80/20 v. CFS polyols average quarterly overcharges
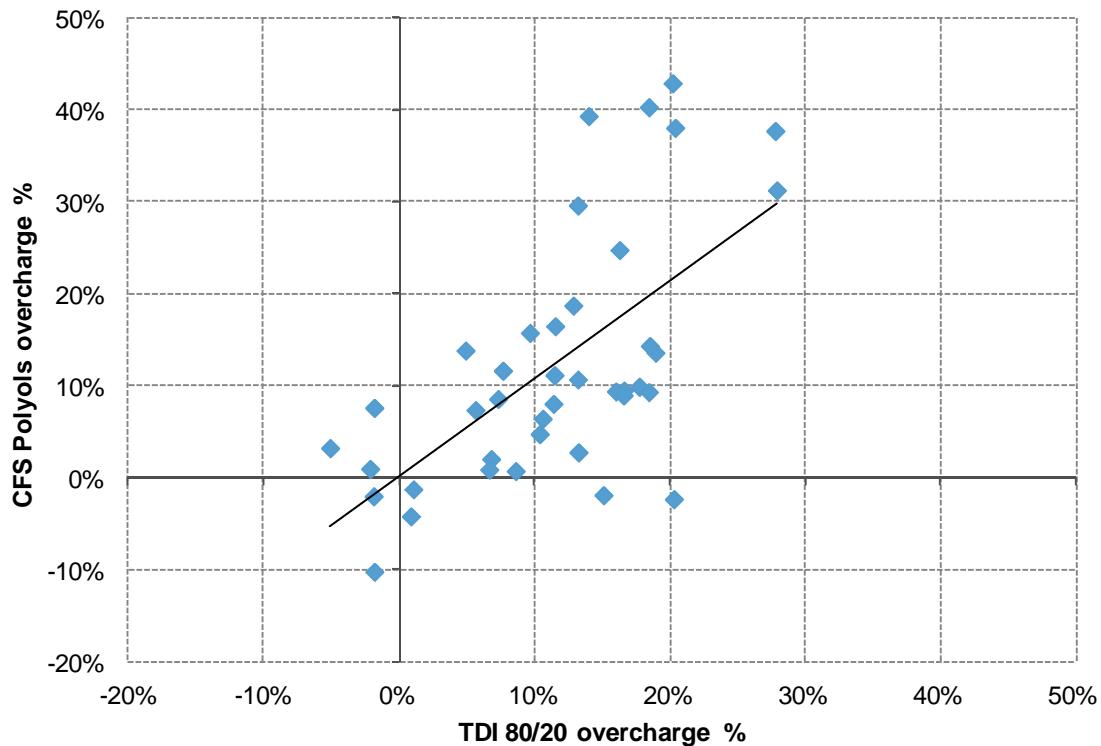
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Figure 17 PMDI v. CFS polyols average quarterly overcharges
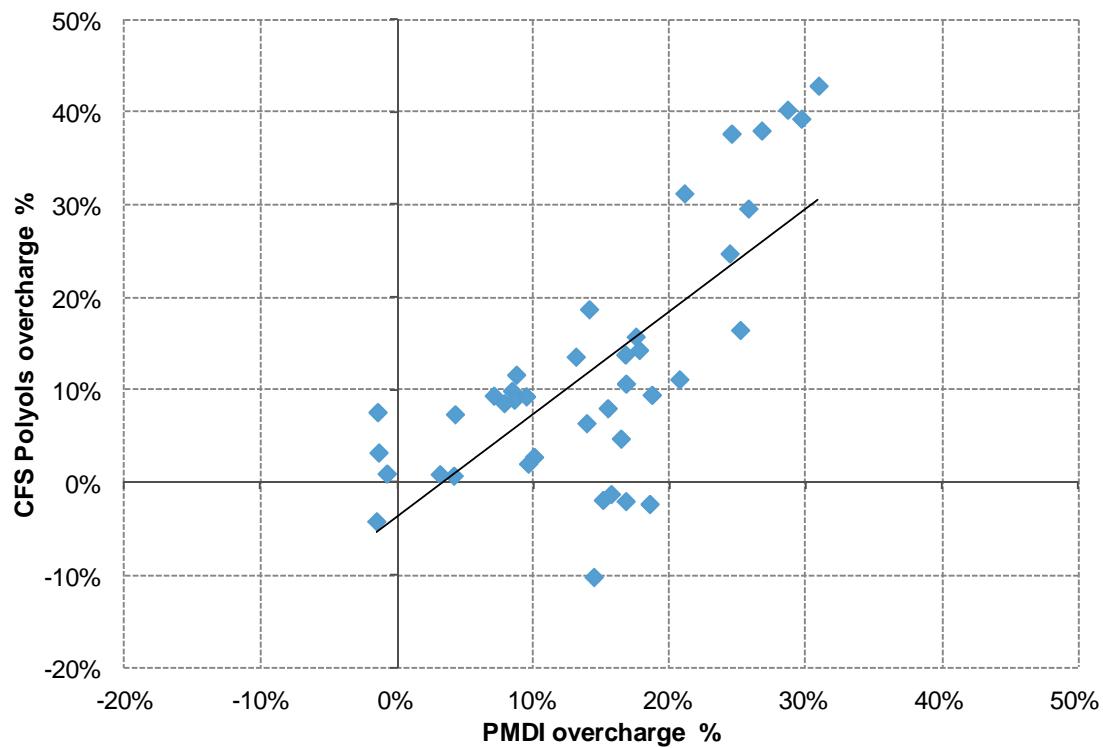
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4. Dr. Ugone's remaining criticisms do not change my opinions

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4.1. Introduction

(153)   In Section 4.2, I show why Dr. Ugone's proposed dummy variable models are unreliable and uninformative. In Section 4.3, I address Dr. Ugone's mistaken criticisms of the data that I relied on.

4.2. Dr. Ugone's dummy variable models are unreliable

(154)   Dr. Ugone reports results of variations of my model that incorporate dummy variables.[221] Dr. Ugone wrongly concludes that his dummy variable models show my econometric model is "not robust."[222] To the contrary, his dummy variable models are unreliable.

(155)   Economists typically use one of two approaches to measure the effects of price-fixing conspiracies on prices: either a forecasting approach or alternatively a dummy variable approach. In this case I used the forecasting approach because it is more reliable for measuring the effect of conspiratorial behavior on price.

(156)   Under the dummy variable approach, the economist specifies a model with single or multiple dummy variables to account for pricing differences (if any) during the conspiracy period. To use a single dummy variable model, Dr. Ugone must make a key assumption: that the overcharges for any particular month must equal the average overcharge for the entire conspiracy period plus some statistical "noise." This key assumption prohibits the statistical noise from varying over time in any way that is correlated with the supply and demand variables.[223]

(157)   The intuitive reason for why the dummy variable model requires this key assumption is that it is attempting to do something quite ambitious: to use nonconspiratorial and conspiratorial prices to estimate nonconspiratorial prices. The only way to use conspiratorial prices to estimate nonconspiratorial prices is to impose stringent assumptions about how Defendants' conspiracy caused conspiratorial prices to differ from nonconspiratorial prices. Crucially, this key assumption is not required of my forecasting model. Rather, it is required only for the dummy variable model.

(158)   If this key assumption is violated, then the dummy variable model will incorrectly attribute some of the variation in the overcharges over time to variation in the supply and demand variables. As

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[221]   Ugone report at ¶¶ 185–94.

[222]   Ugone report at ¶ 180.

[223]   This is a consequence of the standard regression condition that the error term is uncorrelated with the regressors.

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a result, the dummy variable model will not accurately capture the average effect of the conspiracy on prices and will be unreliable.[224]

(159)   The large differences between Dr. Ugone's dummy variable models and my forecasting model are due to the key assumptions being false.[225] As a result, Dr. Ugone's dummy variable models are unreliable.[226]

4.3. I have no reasons to revise the Defendants' data that I relied upon

(160)   Dr. Ugone incorrectly asserts that I failed to use the actual prices paid by certain Plaintiffs,[227] and that I wrongly used transactions where a Plaintiff was listed as the ship-to customer but a Defendant (or other entity) was listed as the bill-to customer.[228]

(161)   Under my direction, my support team performed a substantial amount of work to ensure that the data provided by Defendants accurately reflected the prices paid by the Plaintiffs. My team assisted counsel with data discovery requests, and confirmed with Defendants that their data were the best source for pricing information, including prices net of rebates, discounts, bonuses, etc.[229] For example, Dow was asked in the discovery process whether the transaction data that Dow provided included all "rebates, credits, and debits associated with the sale of polyurethane

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[224] An analogous key assumption is needed to estimate a multiple dummy variable model: the overcharge within each period measured by a dummy variable must equal the average overcharge for that period plus noise. That noise must be uncorrelated with the supply and demand variables. If the key assumption is violated, then the multiple dummy variable model will not accurately capture the average effects of the conspiracy on prices and will be unreliable.

By construction, the key assumption will be satisfied if the dummy variable model has a separate dummy for each month of the conspiracy period. However, the results of such a dummy variable model are mathematically identical to the results of my forecasting model.

[225] There are good reasons to expect the key assumption to fail (i.e., for overcharges to vary over time in ways that are correlated with supply and demand variables). Standard models of imperfect competition indicate that price will be a function of marginal cost, the elasticity of industry demand, and the number of firms competing in the industry. Collusion is tantamount to a reduction in the number of firms competing in the industry. Hence, unless Defendants, *as part of their conspiracy*, chose to forego profits and respond identically to cost and demand during their conspiracy as before and after it, the key assumption necessary to reliably estimate a dummy variable model must fail.

[226] Dr. Ugone performs an alternative dummy variable analysis, which incorporates variable selection. Ugone report at ¶¶ 190–194. This alternative analysis is very likely to exacerbate the limitations of this approach.

[227]   Ugone report at ¶ 203.

[228]   Ugone report at ¶ 201.

[229]   It is worth noting that, as discussed in Appendix E of my initial report, I incorporated and matched rebates, discounts, and returns with their original transactions where record identifiers were present that allowed me to make this calculation. Also, for the purposes of calculating damages, I have taken a conservative approach with ALL adjustment records being netted out and negative overcharges allowed to occur (thus lowering damages).

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products" and whether there were "any rebates or discounts that are not contained in th[e] database." Dow responded that it had "endeavored to capture all rebates, credits, and debits associated with the sales of polyurethanes products in producing the transaction data in this litigation."[230] Dr. Ugone was apparently unaware of this correspondence.[231] My team and I relied on Defendants' representations that their data were as complete as possible.

(162)   In searching the millions of pages of documents produced in this litigation, it is likely that one would be able to find documents that cite or quote prices and pricing terms that may not match the transactional data precisely. Dr. Ugone has unearthed three situations in which the documentary evidence does not perfectly align with the transactional data that Defendants produced. I reviewed these situations to ensure that the data did not suffer from any systematic deficiencies.

(163)   First, Dr. Ugone cited a Carpenter purchase order for TDI 80 from BASF which states that "[r]egardless of the invoice price we [Carpenter] will pay $.56 LB." [232] From this, Dr. Ugone concludes that Carpenter could not have paid more than $0.56 per pound in 2002."[233] This conclusion is incorrect. While the data show that Carpenter, in fact, paid $0.56 in January and February 2002, Dr. Ugone incorrectly assumes that this purchase order was valid for the entire year. [234] Even a cursory review of the record surrounding this time period would have revealed a series of documents which indicated prices exceeded $0.56, consistent with the Defendant-provided data throughout 2002.[235]

(164)   Second, Dr. Ugone cited an unsigned British Vita supply arrangement document in which a price adjustment bonus appears to have been offered.[236,237] Dr. Ugone's claims that I failed to account for these types of adjustments throughout my analysis are mistaken. Dr. Ugone overlooks the fact that: (a) it is unclear if this agreement was ever executed; (b) the minimum volume

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[230]   July 29, 2010 Letter from Jeremy Evans to Gerard Dever and Doreen Manchester, at 22–23. Similarly, BASF confirmed that its data included all rebates and discounts relating to purchases of Polyether Polyol Products by class members in its transactional data. (June 6, 2010 Letter from Jason Fliegel to Matthew Duncan, at 13.)

[231]   *See* Ugone deposition at 793:6-16 and Ugone report at Exhibit 3.

[232]   CC_000000507-0508 at 0507.

[233]   Ugone report at ¶ 204.

[234]   Carpenter's weighted average price for TDI 80/20 from BASF was $0.56 in January and February 2002 and their weighted median price was $0.57 during the same two months. The weighted average and weighted median prices for TDI 80/20 for Carpenter from BASF were over $0.70 in all months after February 2002.

[235]   *See* CC_000003492-96, which shows a price of over $0.70 for the months of June through September of 2002. *See* also CC_000000943-44, and CC_000003501-02.

[236]   Ugone report at ¶ 207.

[237]   Letter from David Freidinger to Richard Loftin and attached Supply Arrangement, May 25, 2001 (Deposition Exhibit 2122: BASF Corporation US 1419583-9585 at 9584).

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requirements necessary to trigger this bonus were not met according to the Defendant transaction data; and (c) I identified adjustment records during the same year of the supply arrangement from the Defendant transaction data for these specific products and this specific customer worth more than double the value of the price adjustment bonus cited in the document.

(165)   Third, Dr. Ugone cited a British Vita supply arrangement document in which a signing bonus was offered.[238]   Although the exact amount of the signing bonus cannot be matched to a specific transaction in the data, the data provided by the Defendants and the data I relied on, appear to contain significant rebates, adjustments, and bonuses worth significantly more than the documented signing bonus, which I appropriately incorporated.

(166)   With regard to the second criticism, that I estimated damages for purchases that were shipped to the named Plaintiffs but billed to someone else, my methodology for identifying Plaintiff purchases was based on instructions from counsel.[239]   Dr. Ugone does not contend that the prices quoted in the data were not the actual prices.   Rather, he appears to be making a legal argument regarding the entity that owns the legal right to the claim.   I do not have an opinion on that legal issue.   In almost every case, the bill-to customer name was a Defendant or Canadian affiliate of the Defendant supplying the product.[240]   I understand that Plaintiffs take the position that they, in fact, paid for these purchases.

(167)   To the extent that these purchases are deemed unrecoverable, it is important to note that Dr. Ugone made a technical error in his attempt to exclude those purchases "that were shipped to the Direct Action Plaintiffs but were not billed to the Direct Action Plaintiffs."[241]   Specifically, in creating Table 12 of his report, Dr. Ugone incorrectly uses ship-to customer information to identify the purchasers in preparation for use in the first stage of my econometric model, but then uses bill-to customer information to identify purchasers in the second stage transaction-level model.   This understates the resulting damages.   I have redone my analysis using bill-to customer information to identify purchasers for both stages of my model, and as seen in Figure 18, the resulting damages are extremely close to the results using my original dataset and are significantly higher than the results reported in Dr. Ugone's Table 12.   In fact, after correcting Dr. Ugone's mistake, the overcharge percentages increase compared to the overcharge percentages in my initial report where I use all the data.

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[238]   Letter from David Freidinger to Richard Loftin and attached Supply Arrangement, June 21, 2002 (Deposition Exhibit 8037: BASF Corporation US 026763–6770 at 6765).

[239]   *See* Appendix B of my initial report.

[240]   These bill-to customers include "BASF CANADA INC", "THE DOW CHEMICAL COMPANY", "ARCO CHEMICAL CANADA INC", and "LYONDELL CHEMICAL CANADA INC".

[241]   Ugone report at ¶ 201.

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Figure 18 Comparison of damages across "bill to" sensitivities

	Class Period			Conspiracy Period		
	Net purchases	Damages	Percent overcharge	Net purchases	Damages	Percent overcharge
Revised Raiff report	$3,033,328,627	$371,148,848	12.2%	$5,431,281,860	$616,787,349	11.4%
Ugone's "bill to" sensitivity	$2,857,897,524	$338,606,460	11.8%	$5,177,452,165	$576,123,070	11.1%
Corrected Ugone's "bill to" sensitivity	$2,857,897,524	$363,183,831	12.7%	$5,177,452,165	$614,458,450	11.9%

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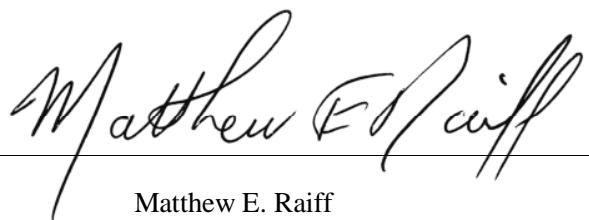
_____   July 13, 2012
_____
             Matthew E. Raiff   Date

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Appendix A. Materials considered

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In addition to the materials listed below, I relied on the materials listed in Appendix D of my May 13, 2011, revised report. As a general principle, I have relied on the materials cited within my reports.

Legal documents and deposition testimony

Expert Reports

- Expert Report and Backup of Matthew E. Raiff, Ph.D., Apr. 15, 2011.

- Revised Expert Report and Backup of Matthew E. Raiff. Ph.D., May 13, 2011.

- Economic Expert Report of Professor Kenneth G. Elzinga and Backup, Mar. 23, 2012.

- Rebuttal Expert Report, Backup, and Exhibits of Keith R. Ugone, Ph.D. Responding to the Expert Report of Dr. McClave, Mar. 23, 2012.

- Rebuttal Expert Report, Backup, and Exhibits of Keith R. Ugone, Ph.D. Responding to the Expert Report of Dr. Raiff, Mar. 23, 2012.

Depositions

- Deposition of Anthony Hankins, Feb. 4-5, 2010.

- Deposition of David Freidinger, Apr. 7, 2010.

- Deposition of G. Thomas Harrick, Nov. 10, 2010.

- Deposition of John Phelps, Sept. 24, 2009.

- Deposition of Keith R. Ugone, Apr. 16–18, 2012.

- Deposition of Kenneth G. Elzinga, Apr. 3–4, 2012.

- Deposition of Marco Levi, May 19–21, 2010.

- Deposition of Matthew Raiff, May 25–26, 2011.

- Deposition of Robert Wood, Feb. 10, 2010.

- Deposition of Thomas Feige, Jr., Dec. 1-2, 2010.

- Deposition of Wayne LeSage, Sept. 30, 2010.

- Deposition of William Long, Oct. 5, 2010.

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Other documents

■ Direct Action Plaintiffs' Second Collective Amended and Supplemental Responses to Defendants' First Set of Merits Interrogatories (Sept. 8, 2011).

■ Memorandum and Order on Class Certification, *In re Urethane Antitrust Litig.*, No. 1616 (D. Kan. 2008).

■ Email from Jodi Trulove to Phil Proger (May 22, 2012).

Publicly available documents

Other antitrust litigation

■ Daubert Hearing Testimony of Halbert White, *In re Linerboard Antitrust Litig.,* No. 1261 (E.D.PA. 2007).

■ European Commission Decision, Case COMP/E-1/37.512, *Vitamins*.

■ European Commission Decision, Case COMP/E-2/37.533, *Choline Chloride.*

■ European Commission Decision, Case COMP/F/38.538, *Butadiene Rubber and Emulsion Styrene Butadiene Rubber.*

■ European Commission Decision, Case COMP/F/38.443, *Rubber Chemicals*.

■ Expert Report of B. Douglas Bernheim, *In re Vitamins Antitrust Litig.* (May 24, 2002)

■ *In re DRAM Antitrust Litig.*, 608 F.Supp.2d 1166 (N.D. Cal. 2009).

■ *In re Linerboard Antitrust Litig.*, 497 F.Supp.2d 666 (E.D.PA. 2007).

■ *In re Vitamins Antitrust Litig.*, 305 F.Supp. 100 (D.D.C. 2004).

■ Plea Agreement, *U.S. v. Bayer Corp.*, No. CR 04-0318 VRW (N.D. Cal. 2005).

■ Plea Agreement, *U.S. v. Elpida Memory, Inc.*, No. CR 06-0059 PJH (N.D. Cal. 2006).

■ Rebuttal Expert Report of Halbert L. White, Jr., Ph.D. *In re DRAM Antitrust Litig.* (May 2, 2008).

■ Ruling on Motions to Strike and For Summary Judgment, *In re Ethylene Propylene Diene Monomer (EPDM) Antitrust Litig.*, Civil Action No. 3:03md1542 SRU (D. Conn. 2009).

■ *United States v. AU Optronic, et al.*, Case No. CR 09-00110 SI, Portions of Transcript of Proceedings ("AUO Trial Tr.") as cited in my report.

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News articles and releases

■ Ivan Lerner, "Plastic Additives Makers Under Global Antitrust Scrutiny," *Chemical Market Reporter* 263, no. 8 (2003), available at http://www.icis.com/Articles/2003/02/21/190732/plastic-additives-makers-under-global-antitrust-scrutiny.html.

■ Marianna Parraga, "Venezuela worries that OPEC is flooding oil market," *Reuters*, April 17, 2012, available at http://www.reuters.com/article/2012/04/17/venezuela-opec-idUSL2E8FHAE020120417.

■ "Prices up; materials demand could slow for rest of year," *Modern Paint and Coatings*, August 1, 1995.

■ "Suppliers face tighter margins, fewer customers," *Modern Paint and Coatings*, August 1, 1996.

■ Tarek El-Tablawy, "OPEC struggles to find balance in oil market," *San Diego Union-Tribune*, November 28, 2008, http://www.utsandiego.com/news/2008/nov/28/opec-meeting-112808/?print&page=all.

■ "US chemicals: easing onto the road to recovery," *Chemical Week*, April 13, 1994.

■ United States Department of Justice, "Bayer AG Agrees to Plead Guilty and Pay $66 Million Fine for Participating in Rubber Chemicals Cartel," news release, July 14, 2004, http://www.justice.gov/atr/public/press_releases/2004/204602.htm.

■ United States Department of Justice, "Taiwan-Based AU Optronics Corporation, its Houston-based Subsidiary and Former Top Executives Convicted For Role in LCD Price-Fixing Conspiracy," news release, Mar. 13, 2012, http://www.justice.gov/atr/public/press_releases/2012/281032.htm.

Websites and other sources

■ Antitrust Modernization Commission, Report and Recommendations (2007) at 301, available at http://govinfo.library.unt.edu/amc/report_recommendation/toc.htm.

■ BASF Corporation, "What is verbund," http://www2.basf.us/about/verbund.html.

■ Dow, "About Propylene Oxide," www.dow.com/propyleneoxide/about/index.htm.

■ Oxera Consulting, et al., Quantifying Antitrust Damages: Toward Non-Binding Guidance for Courts (2009), available at http://ec.europa.eu/competition/antitrust/actionsdamages/quantification_study.pdf.

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- Proving Antitrust Damages: Legal and Economic Issues (1st ed. 1996), ABA Section of Antitrust Law.

- Reference Manual on Scientific Evidence (2d ed. 2000), ABA Section of Antitrust Law.

- SRI Consulting, "CEH Product Review Polyester Polyols" in Chemicals Economics Handbook (2006).

- United States Department of Justice, "Appendix A: Antitrust Division Selected Criminal Cases April 1, 1996 through September 30, 1999," http://www.justice.gov/atr/public/4523d.htm.

Publicly available data

Series Name	Source
Durable consumer goods industrial production index	Federal Reserve Economic Data

Bates-stamped documents

First Bates number	Last Bates number
BASF Corporation US 026763	BASF Corporation US 026770
BASF Corporation US 0997828	BASF Corporation US 0997949
BASF Corporation US 1128261	BASF Corporation US 1128352
BASF Corporation US 1419583	BASF Corporation US 1419583
BC/PUR02936633	BC/PUR0293715
CC_000000507	CC_000000508
CC_000000943	CC_000000944
CC_000003492	CC_000003496
CC_000003501	CC_000003502
FSI_000000230	FSI_000000230
HC000943168	HC000943537
HC00166735	HC001667506
TDCC_PU0767196	TDCC_PU0767225
TDCC_PU239658	TDCC_PU239731

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